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MODULAR TRANS–01
TRANSFER LINE CONTROL
USER'S MANUAL

No. IA 74718
Revision A
October, 1987

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CHAPTER 1. GENERAL DESCRIPTION

1.1 INTRODUCTION

1.1.1 The TRANS-01 Family Of Controls

The Indramat TRANS-01 Transfer Line Control family is a series of microprocessor-based programmable controls designed for control of transfer lines and other high production machining systems. The TRANS is a single-axis control, designed to provide numerical control of an Indramat MAC AC servo drive used as a feed drive operating slide or rotary table.

The TRANS is available with software options for feed ramp, adaptive depth control, adaptive feed control and rotary motion control. Hardware/software options include external tool correction interface modules for 115 VAC signals and mounting in the sealed KSC enclosure with servo and spindle drives.

TRANS-01 M Modular Transfer Line Control

This document describes the TRANS-01 M Modular Transfer Line Control System. It is an open-frame construction electronic module designed for panel-mounting in a sealed enclosure, such as a NEMA-12 cabinet or KSC together with a power supply and one or more AC controllers (generally one for the feed axis servo drive and one for the spindle drive).

The TRANS-01 M is generally used in a flexible machining system or a dial-type (rotary) machine, where one TRANS is used per station. In turn, multiple TRANS controls are under the system control of the customer's Line Control device, such as a programmable controller or computer. This device can communicate with any TRANS control, uploading and downloading parameters, programs, status and diagnostic information. This can be accomplished using Indramat's Line Control Adaptor, which provides a communication link with up to 30 TRANS controls.

The TRANS-01 M controls are often built into a machine cabinet and are not readily accessible to an operator. The operator communicates to the modular TRANS via a TAM keyboard/display. A plug-in TAM 2.01 keyboard/display module is mounted in a convenient location for the operator and cabled to up to 10 TRANS-01 M controls. A system with more than ten TRANS modules requires multiple TAM's.

Alternately, a portable plug-in TAM 2 keyboard/display is carried to the machine and plugged into an individual TRANS-01 M as needed for parameter entry, programming, tool correction entry and data and diagnostic display.

TRANS-01 Distributed Control

The TRANS-01 control, as opposed to the Modular TRANS-01 M, is supplied in a rigid, compact, sealed enclosure, designed for wet machining environments. One TRANS-01 is generally mounted directly at each station of a transfer line for true distributed control. Each TRANS-01 has a built-in operator panel which has the same functions as the TAM keyboard/display panel.

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Distinctions Between TRANS-01 and Modular TRANS-01 M

Most programming and operator functions, plus actual operation of the TRANS-01 and TRANS-01 M are identical. However, interfacing, mounting and installation of the two controls are quite different. In addition, the Modular TRANS-01 M offers certain signal lines and options not available on the TRANS-01.

Thus, it is important that you refer only to this document for data on the Modular TRANS-01 M. Refer to Indramat document IA 30058 for information on the TRANS-01.

1.1.2 Description of Modular TRANS

The TRANS-01 M is intended for remote operation, where it is controlled by the customer's Line Control device, usually a computer or a programmable controller which controls the entire flexible machining system. The function of the customer's Line Control device is to convey commands to and receive information from each TRANS in the system. It can do this using discrete wires to each TRANS -- the parallel Cycle Interface -- or it can use Indramat's optional Line Control Adaptor (LCA) and communicate using one RS-232 serial channel throughout the system. The Cycle Interface provides control lines for one TRANS-01 M while the Line Control Adaptor (LCA) can communicate with up to 30 TRANS controls, receiving status and position data, transmitting commands and downloading programs and parameters.

The customer's Line Control can control the TRANS via the LCA, or the LCA can be used to monitor position and status information for display, with the actual control handled over the Cycle Interface. This is determined by setting up TRANS parameters.

The TRANS can be operated both on-line, controlled by the customer's line control, and off-line, controlled either from an Operator Station mounted on the machine and/or by the TAM keyboard/display panel.

Two models of the TAM keyboard/display are available. The TAM 2 is a portable unit which is plugged into a single TRANS control when needed. The TAM 2.01 is a machine-mounted unit which communicates with up to 10 TRANS controls via daisy-chain cabling.

A typical system consists of several TRANS-01 M controls, with one (or more) TAM keyboard/display modules per 10 TRANS controls.

Each TRANS can provide control for:

1. One feed axis -- controlled by an Indramat Servo Controller (amplifier), such as a TDM with a model MAC AC Servomotor (with integral incremental encoder for position feedback).

2. One spindle drive -- controlled by an Indramat spindle controller, such as the TWM or KDW, with a MAC AC spindle motor.

Complete interconnect cable sets are also available from Indramat. Components are chosen to best fit the required application, and are matched through plug-in personality modules to provide optimum performance without the necessity for further field adjustments.

Figure 1-1 is a block diagram illustrating typical system configurations.

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Both positioning accuracy and system speed are optimized by utilizing closed loop digital positioning. The axis can be positioned either incrementally or absolutely.

The TRANS-01 M control includes a memory which can store up to 128 program blocks. Each block contains up to 8 instructions which are: Homing or Position Command, Feedrate or Dwell Time, Auxiliary Functions, BCD Output, Tool Correction, Spindle RPM Output, Block Repeats and Program Jumps.

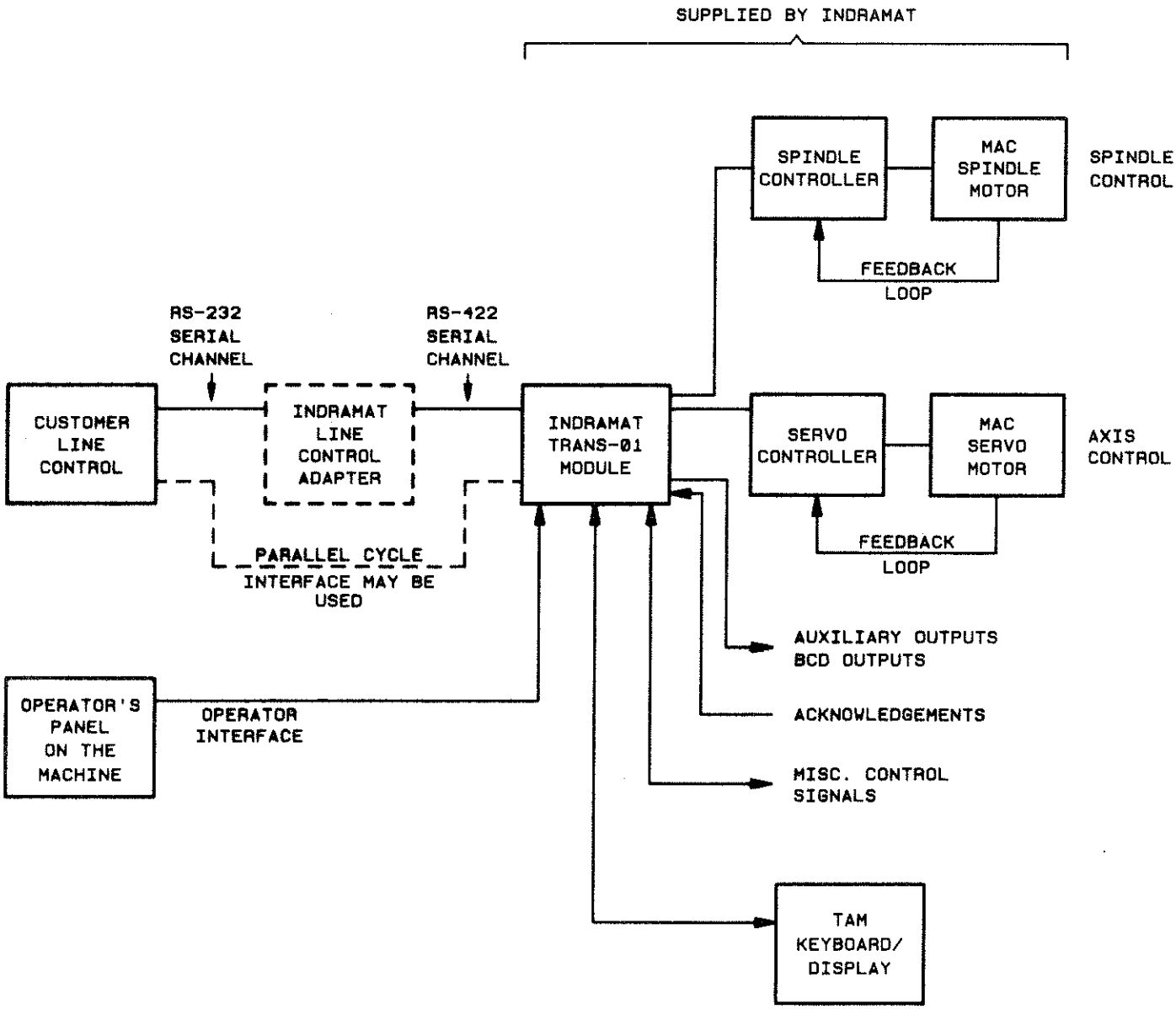
Additional instructions for special applications are available with certain modular TRANS software packages.

1.1.3 Programming

The TRANS control can be programmed using either of two methods:

1. The TAM keyboard/display panel.
2. Indramat's optional Line Control Adapter (LCA), a microprocessor-based serial bus driver (RS-422).

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NOTES

1. The Parallel Cycle Interface and Line Control Adaptor may be used in the same system.

2. If the optional Line Control Adaptor is not used, the customers Line Control device communicates directly with the TRANS using the Parallel Cycle Interface.

Figure 1-1. TRANS-01 M System Block Diagram

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1.1.3.1 Programming with TAM Keyboard/Display

As previously mentioned, either the portable or fixed TAM keyboard/display can be connected to the TRANS control. The two units function identically.

The TAM keyboard is used for programming, start-up and service. The TAM also includes an alphanumeric display for display of current program data, axis position data, system status, diagnostics and program information.

Using simple English commands, the TRANS-01 M user program is entered via the keyboard and display directly into the CMOS memory of the control. Program changes and editing of program data are accomplished in the same manner using the TAM keyboard/display.

1.1.3.2 Line Control Adaptor

Indramat's Line Control Adaptor (LCA) is designed to communicate simultaneously over an RS-422 serial link with up to 30 TRANS-01 M controls on a high production line.

The LCA receives data, such as slide position, diagnostics, I/O status, etc. from each connected TRANS and buffers the information in its RAM memory. An RS-232C port on the front of the LCA connects to a user-supplied device used to manipulate the data. This device can range from a dumb terminal to a large computer. Once connected to the LCA, this device (called the Line Control) can request and obtain status information from any or all TRANS-01 M controls on the line. It can upload complete part programs, parameters, diagnostics and tool corrections. Additionally, the Line Control can transmit programs, parameters and tool corrections to any TRANS on the bus, and transmit commands such as Start, Enable and Homing.

See Indramat publication IA 74706 for complete information on the Line Control Adapter, including instructions on how to transmit programs, parameters and commands to the TRANS over the RS-422 serial channel.

1.1.4 Diagnostic Monitoring

The TRANS continuously monitors all important functions of the system for correct operation. This includes all inputs, outputs, operating voltages, axis components, servomotor, spindle motor (when present), tachometer, incremental encoder, limit switches, parameters and the user program. The monitoring is done at all times, whether a TAM keyboard/display unit is connected or not.

When operating faults or disturbances are detected, the control switches to the Diagnostic Mode and shuts the system down. When a TAM keyboard/display module is connected and the control number of this TRANS has been selected, a simple English Language diagnostic message appears on the display. This aids in the quick determination and correction of faults.

A special advantage is that the TRANS records causes of problems, and also diagnoses and identifies faults which trigger sequential events, such as loss of main power. This aids in quick correction of faults by plant personnel, rather than specialized electronic technicians.

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The diagnostic status of the control can be interrogated at any time, even when no error is present, by selecting Diagnostic Display Mode. Thus, normal status indications, such as "NO START", can be observed; and causes of interruptions which do not appear as errors, such as the control waiting for an auxiliary function acknowledgment, can be determined.

When using a TAM, the TRANS NUMBER of a control is selected on the TAM, then Diagnostic Display Mode is selected to examine the diagnostic status of that control.

In on-line operation, the diagnostic status can be examined by the customer's Line Control via the data bus (and Line Control Adaptor, if present).

1.1.5 Adaptability of the Control

The TRANS is integrated to the machine and the axis and spindle drives by entering various parameters when the system is initialized, e.g., maximum feedrate, accel/decel rate, incremental encoder cycles per revolution, etc.

This feature allows drive conditions and positioning resolution characteristics for a number of different machines to be adapted to a single type of control, with the control then producing correct position gain. Thus, standard programming procedures are maintained regardless of machine structure.

With this system, ballscrew pitch and gear ratios can be chosen based solely on thrust needs and desired rapid traverse rates. Thus, drives and position encoders can be standardized. This concept permits standard components to easily be adapted to differing machine requirements, reduces requirements for spares, and allows quick and easy replacement of controls by plant electricians if service is necessary.

1.1.6 Options

A number of hardware options are available with the TRANS, including external tool correction and interface modules for 115 VAC signals. By installing the appropriate optional software, adaptive depth control, feed adaption, rotary motion control and/or feed ramp capabilities are provided.

Options, including interfacing and programming, are discussed in Chapter 9.

1.2 OPERATING MODES

The Modular TRANS is a complete NC control and can be operated off-line or can be tied to a Line Control system over a data bus. This permits TRANS to be employed for completely self-contained tasks.

When complete processing lines are put into initial operation, this off-line capability allows initial operation and testing of each TRANS unit, even before the Line Control installation has been completed.

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The following modes of operation are provided by the TRANS for execution of its control functions:

Automatic Operation -- Remote operations via the Cycle Interface signals supplied from the customer's Line Control device.

Functions Include:
- Programmed motions
- Single cycle
- Emergency home

Operator Interface -- Operation using pushbuttons mounted on an operator control panel external to the TRANS.

Functions Include:
- Programmed forward motion (via pushbutton)
- Programmed reverse motion (via pushbutton)
- Move to toolchange position

Set-up Operation -- Operation using the TAM keyboard/display.

Functions Include:
- Homing
- Continuous operation
- Single block operation
- Jogging forward and reverse

1.3 DISPLAY MODES

The TAM keyboard/display provides the following display modes for programming, program testing, checking system status, and operator and service support.

1. Block display for:
   - Programming
   - Program review
   - Display of the current block during program execution

2. Display of actual position, actual feedrate and actual auxiliary function status.

3. Display of commanded position (destination), programmed feedrate and programmed auxiliary function status.

4. Display of following error (deviation), feedrate override and existing discrepancies between commanded auxiliary functions and their respective expected acknowledgments.

5. Display of current programmed feedrate, feedrate override, BCD output, spindle speed, currently selected tool correction register number, and current reverse vector block number.

6. Status and fault diagnostics.

7. Tool correction display mode.

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1.4 ENGLISH LANGUAGE PROGRAMMING

The basic program for standard motions is preprogrammed. The user simply prepares a program of up to 128 motion control blocks, each consisting of up to 8 operating commands such as type and length of axis movement, feedrate, homing, BCD outputs, spindle speed, dwells and auxiliary operations. Jump programming (including a jump based on external inputs) and repetition of one or a number of commands is easily selected for programming cyclic operations.

Tool position corrections can be programmed to allow operator compensation for tool wear.

When using numeric controls, programming a control requires the memorizing of many NC codes and symbols that are recognizable by the control, but not particularly meaningful to the operator. This problem is eliminated in the Modular TRANS, by using simple English language dialog programming. The TRANS "talks" with the programmer, requesting him to select a function, then prompting him through the entry of the information required to perform that function, using simple English prompts on the TAM display.

1.5 TAM KEYBOARD/DISPLAY PANEL

The TRANS-01 M is simple and easy to program. The TAM contains all controls and indicators necessary to program and operate the control. The program keys are identified with ISO symbols which indicate their function.

The keyboard/display panel is used:

1. To enter parameters such as maximum feedrate, rapid traverse rate, etc., which are used to adapt the control to the characteristics of a particular machine.

2. To enter a control program to perform the required machine functions.

3. To enter tool correction values.

4. For operation of the control in Single Cycle, Single Block and Hand Modes.

5. For display of diagnostic codes which indicate the nature of any problems detected in the machine, control, motor and feedback loop.

1.6 USER ACCESS LEVELS

Access to the TRANS-01 M functions is, for practical needs, divided into 5 levels. They are interlocked to provide the widest possible margin of safety to prevent misuse of the control.

1. Engineering Interface

   At this level, the TRANS is adapted to the drive and machine via input of parameters either by entering them via the TAM keyboard/display or by downloading them via the Line Control Adaptor.

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The first parameter, P00, is the TRANS-NUMBER which determines the address each TRANS control will have on the TRANS-BUS. This must be manually set with two selector switches on the TRANS module. Each TRANS in a system must have a unique number from 01-30. (Versions TRANS-01 M00 and M01 require an operator set-up procedure for parameter P00. See Section 4.9 for details.)

Once a TRANS is assigned a unique TRANS-NUMBER, it can be addressed by the TAM or LCA and parameters can be entered. Because the entry of incorrect data can result in damage to the machine, access at this level is possible only by using the Parameter Keyswitch on the TAM to enable Parameter Entry/Edit Mode. Parameter entry is described in Chapter 4.

2. Programmer Interface

At this level, the control program is entered, and possibly edited, in Dialog Mode. This program must be protected from accidental or intentional alteration by unauthorized personnel. Thus, access to the user program can be made only by utilizing the Programming Keyswitch on the TAM to enable Programming Entry/Edit Mode. Programming entry is described in Chapter 5.

3. Toolsetter Interface

Operations at the toolsetter level are possible when the panel cover of the fixed TAM is unlocked or when the portable TAM is plugged into the system, and the proper TRANS NUMBER is selected. The toolsetter can then examine the program and parameters, operate the manual controls and enter tool correction values, as described in Chapter 3. He cannot change the program or parameters without using a keyswitch to separately enable each of those modes.

4. Operator Interface

Because it is necessary for an Operator to have access to Manual Mode controls in the course of normal operation, the TRANS includes a parallel interface for a unit Operator Station. This station, and its control buttons and switches, is provided by the machine builder. Normal programmed movements (including forward, reverse, homing and move to toolchange position), can be commanded from this station, assuming the necessary enables are provided by the TRANS. Operator functions are described in Chapter 3.

5. Cycle Interface

For operation of the TRANS-01 M by the customer's Line Control, it is equipped with a parallel cycle interface over which operating commands can be transmitted. In Automatic Mode, all control of the TRANS occurs either via this interface or the optional Line Control Adaptor. The Cycle Interface is described in Chapter 6.

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1.7 SYSTEM ELEMENTS

The TRANS-01 M Control System includes:

* The control computer with diagnostic system and monitor logic.
* An EPROM memory for the executive program and a CMOS memory for user programs and data, protected for up to 10 years against power failure by battery backup.
* Numerical control interface for the axis with input circuitry for the incremental position encoder, travel limit switches and homing switch.
* Interface for the spindle control, including various status lines.
* Input/output bus interface for the customer's Line Control.
* Signal interface for an Operator Station panel.
* Control and monitoring for up to 8 auxiliary functions.
* Interface for external tool correction input.

1.8 TECHNICAL DATA

Dimensions and Physical Specifications

TRANS-01 M

height	15.36 in (390 mm) -- At least 3 in (76 mm) must be allowed top and bottom for plug-in connector access.
width	4.14 in (105 mm)
depth	12.45 in (316 mm)
weight	16 lb (7.25 kg)

TAM keyboard/display module specifications

	TAM 2 (Portable)	TAM 2.01 (Fixed)
height	17.41 in (442 mm)	16.08 in (408 mm)
width	12.25 in (311 mm)	12.45 in (316 mm)
depth	3.27 in (83 mm) including connector	2.56 in (65 mm) plus .79 in (20 mm) for connector. 14.42 in (366 mm) req'd for panel door swing clearance.

Power requirements	
Power consumption	TRANS only -- 20 watts
Control power	+24 VL -- 0.7A w/o TAM; 1.0 A with TAM +15V -- 0.05A -15V -- 0.05 A
Ambient temperature -- operating range	0 - 45^{O} C (32 - 113^{O} F)
Control interconnections	via plug-in connectors

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Control Specifications

Number of feed axes controlled	one
Number of spindle axes controlled	one
Dimensioning system	inch or metric
Programming resolution	0.0001 inches; 0.001 mm
Maximum traverse	+/-838.8600 in; +/-8388.600 mm
Feedrate	programmable
Rapid traverse rate	programmable
Maximum system speed	0.1 to 3200.0 in/min; 1.0 to 32000 mm/min
Maximum rapid traverse rate	3200.0 in/min; 32000 mm/min
Jogging	Forward/reverse
Number of program blocks	up to 128
Repetition cycles/blocks	up to 99
Programmed tool position corr.	up to 20 correction registers
Dwell time	programmable from 0.01 to 99.99 sec
Auxiliary functions	up to 8, individually programmable on/off
Adjustable machine parameters	include encoder pulses/motor rev., maximum feed rate, jog speed, inch/metric units, auto home direction reversal, zero reference position, rapid traverse rate, jogging speed, motor direction reversal, spindle rpm/10 volts.
Self diagnostic conditions	detection of over 50 possible malfunctions including: drive fault, encoder fault, parameter invalid, motor overtemperature, limit switch activated, servo voltage error, normal stop, enable signal missing, auxiliary function acknowledgment missing, memory overflow.

Interface Requirements

Input signals	+24 Vdc, I min = 0.01 A, isolated from internal control circuitry.
Output signals	+24 Vdc, I max - 50 mA (Cycle Interface and BCD outputs)/150 mA (auxiliary outputs) per output, short circuit protected, isolated from internal control circuitry.

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Interfaces (Described in detail in Chapter 6)

Parallel cycle interface	used to exchange control, interlock and status information with the customer's Line Control.
Parallel operator interface	used for control signals to/from a Local Operator Station.
Servo interface	provides control of a servo drive with incremental position feedback and inputs for home and overtravel limit switches.
Spindle interface	provides control of a spindle drive with control signals for proper operation and monitoring.
Auxiliary functions/ acknowledgments	used for direct control and acknowledgment of program dependent switching functions.
RS422 serial interface bus	used for high speed communication with Indramat's Line Control Adaptor (LCA). Functions include: program or parameter downloading or uploading, status and diagnostics reporting, and line operation.
TAM serial bus	used for communication between the TAM keyboard/display and up to 10 TRANS control modules.

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CHAPTER 2. TAM CONTROL PANEL DESCRIPTION

2.1 PHYSICAL DESCRIPTION

2.1.1 General

Two models of the TAM keyboard/display are available. One portable and one designed for permanent mounting at the machine. The TAM modules are identical in function, but they differ physically. Throughout the functional descriptions in this document, "TAM" refers to either unit. Where a specific unit is discussed, it will be referred to as TAM 2 (portable) or TAM 2.01 (fixed).

2.1.2 TAM 2 Portable Keyboard/Display Unit

Figure 2-1 is an outline drawing of the portable TAM 2 keyboard Display. It is designed to be hand-carried to the machine, then hooked to a TRANS using a serial cable from the connector in the lower left corner of the panel to either connector X4 or X5 on the TRANS.

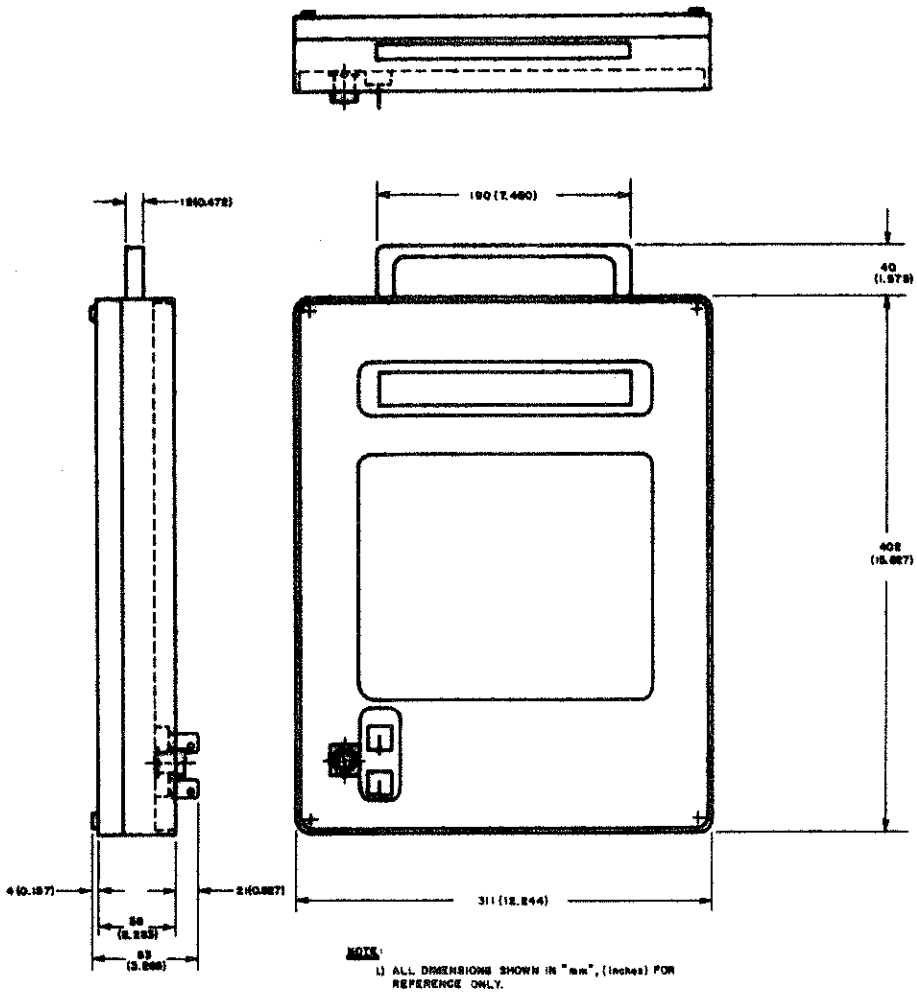


Figure 2-1. Outline Drawing -- TAM 2 Portable Keyboard/Display

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2.1.3 TAM 2.01 Permanently Mounted Keyboard/Display

Figure 2-2 is an outline drawing of the TAM 2.01 Keyboard/Display. This unit is designed for permanent mounting on the machine. It features a lockable front cover which provides sealed protection for the keyboard. A window in the cover provides visibility for the 32 character alphanumeric display at all times.

A connector on the rear of the TAM 2.01 is used to interconnect the TAM to the X4 or X5 connector on the TRANS. Up to 10 TRANS modules can be daisy-chained (via the X4, X5 connectors) to one TAM. See Chapter 7 for a discussion of mounting and installation.

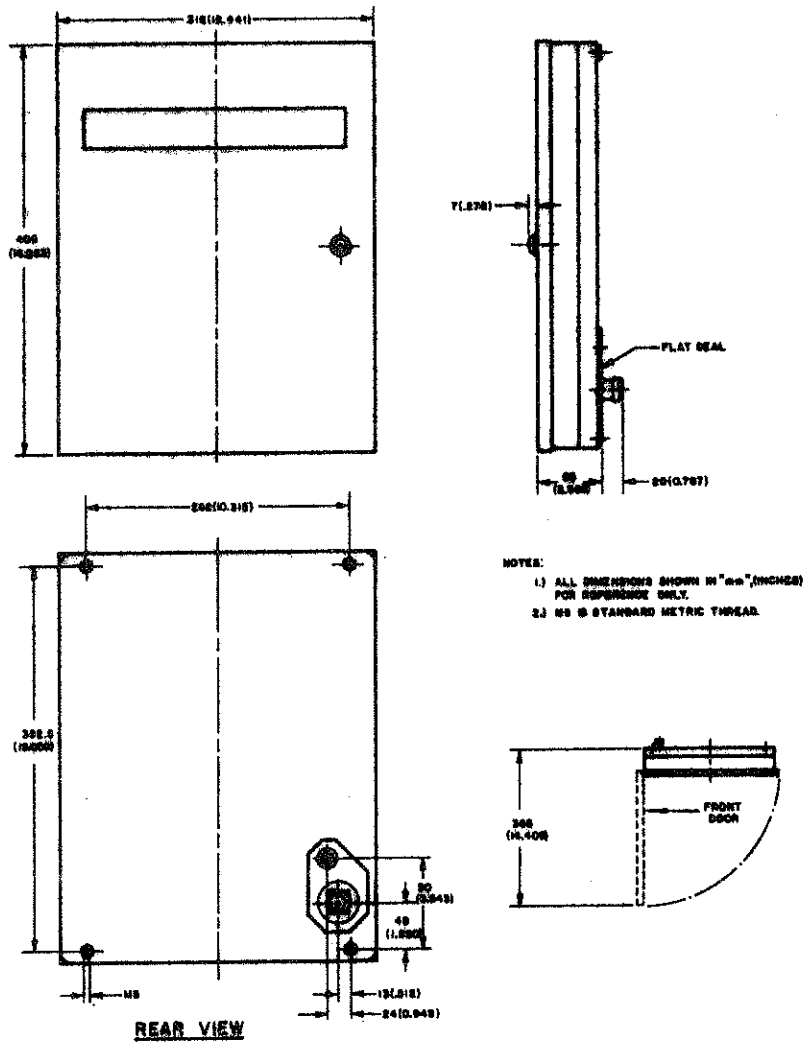


Figure 2-2. Outline Drawing - TAM 2.01 Permanently Mounted Keyboard/Display Unit

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2.1.4 TAM Keyboard/Display Panel Description

Figure 2-3 illustrates the TAM keyboard/display panel. Note that the keys, switches and diagnostic displays are identical for both model TAMs as well as for the TRANS-01.

This chapter describes the individual functions of all the keys, switches and indicators. Chapter 3 describes the use of the TAM in operating the TRANS; Chapter 4 describes the use of the TAM in entering parameters and Chapter 5 describes programming using the TAM.

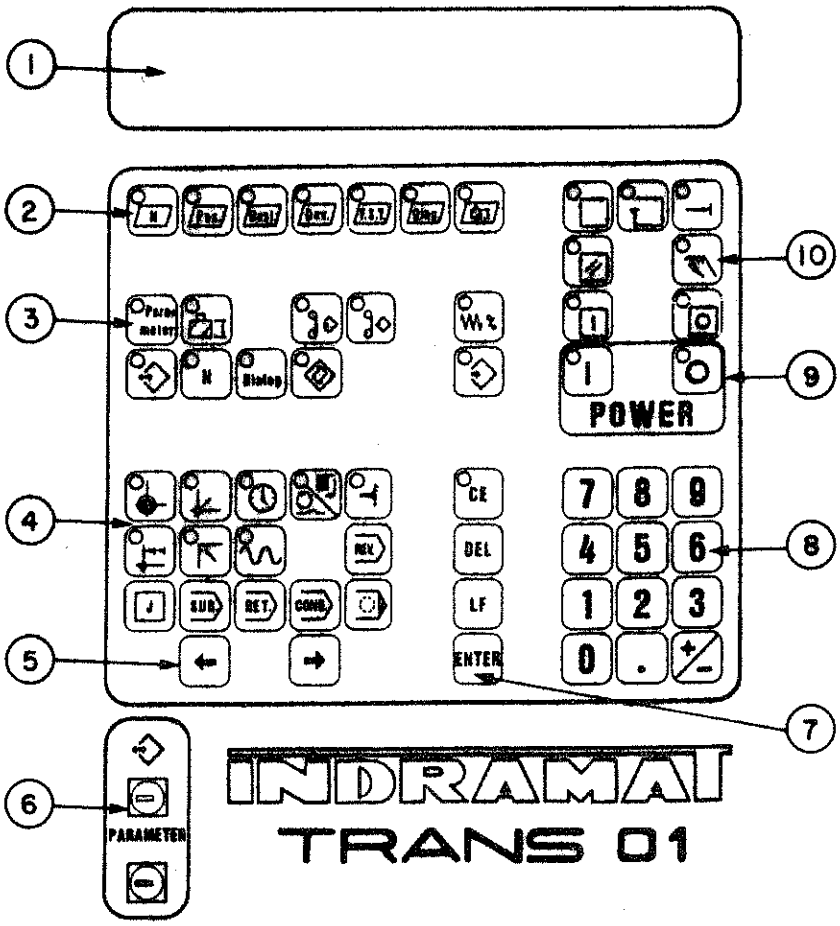


Figure 2-3. TAM Control Panel

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The TAM consists of a 32 character alphanumeric display; several groups of pressure sensitive membrane-type switches, including a numeric keyboard cluster; and, on the lower left, two keyswitches. Several of the keys include an LED in the upper left hand corner. These are illuminated to indicate the current status of the system; informing the operator what mode the alphanumeric display is in, what functions are contained in the current block, etc. These are described in more detail in following paragraphs.

The keyboard uses standard ISO symbols for various key functions. Figure 2-4 is another illustration of the keyboard with each symbol labeled. This is a copy of a paste-in sticker that is mounted inside the door of every TAM 2.01 fixed keyboard/display.

Callouts in Figure 2-3 indicate various elements of the panel, including several functional keygroups. The callouts are:

1. 32 Character Alphanumeric Display -- Displays program block data, parameters, current control status, and diagnostic messages. It is used in programming and parameter entry/edit to provide a dialog, prompting the operator with English language messages as he enters or changes program blocks or parameters.

2. Display Mode Selection Keys -- Used to display system status, including actual position; commanded position; deviation (position lag); feedrate, BCD outputs and tool correction data; and diagnostics.

3. Programming and Parameter Mode Keys -- Used to select and control the parameter entry and programming process.

4. Programmable Function Keys -- Used to select various functions during the programming process.

5. Jog Keys -- Used for forward and reverse jogging in Manual Mode.

6. Keyswitches -- Provide memory protect functions. A Program key must be used to enable Program Entry/Edit mode. A Parameter key must be used to enable Parameter Entry/Edit mode. Without these keys the program and parameters can be displayed, but cannot be changed.

7. Miscellaneous Keys -- These keys are used in Program and Parameter Entry/Edit and Toolsetter Modes to clear errors, delete data and properly terminate the entry of data lines.

8. Numeric Keypad -- Used to enter numeric information into the control.

9. Power Indicators -- Indicate the on/off status of servo drive power.

10. Operation Mode Keys -- Used to select various operating modes.

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2.2 32 CHARACTER ALPHANUMERIC DISPLAY

The alphanumeric display is used to display:

1. English prompts to guide the user as the program commands and parameters are entered.
2. The actual command and parameter information as it is keyed in.
3. System status.
4. Program blocks, parameters words, diagnostics and tool correction values selected for review from the keyboard.
5. The current program block as it is executed.
6. Error diagnostic messages as they occur.

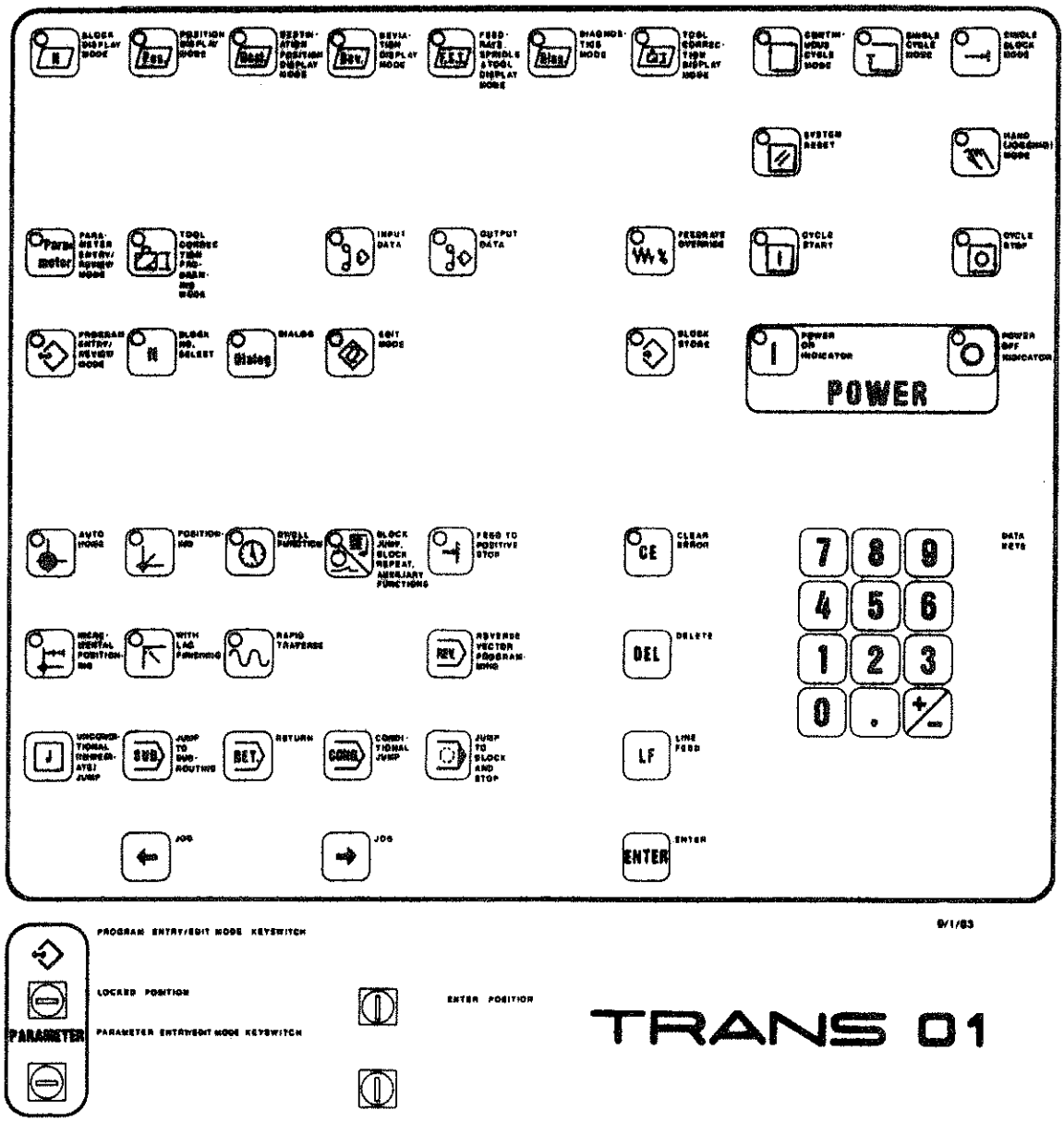


Figure 2-4. TAM Keyboard with Labels for ISO Key Symbols

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2.3 DISPLAY MODE SELECTION KEYS

The top row of keys selects the type of information to be displayed in the alphanumeric display. The control will always be in one of these modes (while power is on).

Key	Mode Selected and Description
	Block Display Mode. When this key is pressed, the alphanumeric display indicates the functions used in the current block, as: X - indicates a feed length programmed. XF - indicates a feed length and feed speed programmed. Additional information is provided as you step through a display sequence, as described in Section 3.5.1. This key selects block display only. It cannot select data entry.
	Position Display Mode. Selects a display of the actual position of the slide, the actual feedrate (feedrate x feedrate override %) and the current auxiliary device status (state of acknowledgments).
	Destination Position Display Mode. Selects a display of the commanded (destination) position of the slide, the current programmed feedrate and the programmed auxiliary function status.
	Deviation Display Mode. Selects a display of the position deviation (position error or lag) of the slide, the feedrate override (in percent) and the auxiliary function deviation. The position deviation is the difference between the actual position and the commanded position. The auxiliary function deviation indicates any functions commanded, but not yet acknowledged.
	Feedrate, BCD and Tool Display Mode. Selects a display of the current programmed feedrate, feedrate override, selected BCD output, current tool correction register number, and current reverse vector.
	Diagnostics Mode. This is the normal display mode, where the control displays a diagnostic error message if an error has been detected or indicates the status of the system, i.e., operating, dwell, waiting for auxiliary acknowledgment, etc.
	Tool Correction Display Mode. Displays amount of programmed compensation in the tool correction register currently in use within the user program.

The LED on one of these keys will be illuminated to indicate the current display mode.

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2.4 PROGRAMMING AND PARAMETER MODE KEYS

This group of keys selects and controls parameter entry and the programming process.

Key	Mode Selected and Description
	Parameter Entry/Review Mode. This key is effective only when the control is not in Automatic Mode. If the Parameter keyswitch has been used to select Parameter Entry/Edit Mode, the control will accept machine parameter data, such as maximum feedrate, rapid traverse rate, inch or metric mode, accel/decel ramp, etc. If the keyswitch has not been set to the Parameter Entry/Edit position, pressing this key allows only review of the parameters.
	Tool Correction Programming Mode. In this mode, tool corrections can be entered into up to 20 tool correction registers or can be reviewed. This key is effective only when the control is not in Automatic Mode. Tool Correction Programming Mode is not affected by the Program and Parameter keyswitches.
	Program Entry/Review Mode. When the control is not in Automatic Mode, this key can be pressed to select Program Read Mode, where program blocks can be read into the alphanumeric display for review. This key is used in conjunction with the N key (Block Number Select - described below) to read a block. When the Program keyswitch has been used to select Program Entry/Edit Mode, this key is used with the DIALOG and EDIT keys to create and edit part programs.
	Block Number Select. Selects a specific block number for inspection, programming or editing.
	Dialog. When this key is pressed in Program Entry/Edit Mode, an English language dialog is created between the control and the user as a complete program block is entered into a buffer. The TRANS will utilize the alphanumeric display to request the user to select some function to be performed, then it will prompt the user through the programming of a block to execute that function. This is the normal mode of program entry, and is described in detail in Chapter 3.
	Edit Mode. This mode is used to revise some portion of a program or parameter block. When selected, allows numerical data within a block to be changed. Note that only numerical data can be changed. If a different function is desired, Dialog Mode must be used to change the program. This key is effective only when program Entry/Edit Mode or Parameter Entry/Edit Mode has been enabled using the proper keyswitch.

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2.5 PROGRAMMABLE FUNCTION KEYS

These keys are used in response to program entry dialog prompts to select various functions to be programmed into the individual program blocks.

Key	Description

The five keys in the first row of Programmable Function keys can be pressed in response to the "Function?" question during Dialog programming.



Auto Home. This function returns the axis to its home position. The Auto Home NC code is G0 (appears in alphanumeric display).



Positioning. This function is used to position the axis. The dialog will request distances, feedrate, absolute or incremental positioning, and whether the axis must be in position before continuing with the next positioning command. The Positioning NC code is G1.



Dwell Function. Allows programming a dwell function of from 0.01 to 99.99 seconds in the present block. The NC code is G4.



Block Jump, Block Repeat, Auxiliary Functions. This key enables the programming of several different functions in the current block, including: block jumps (unconditional, conditional, subroutine jumps and returns), block repeats (up to 99 times), spindle speed, tool correction register number and auxiliary outputs (turn up to 8 lines on or off).



Feed To Positive Stop or Select Optional Function. Allows programming a feed into a positive stop at a parameter-determined torque setting. The NC code is G5. This key can also be used to select optional adaptive depth control (see Section 9.2 for details).

The next two rows of Programmable Function keys are used to complete the programming of the function selected by one of the five keys in the first row.

Key	Description



Incremental Positioning. When programming a block where axis positioning takes place, the dialog display will be ABSOLUTE? Pressing LF (Line Feed) selects absolute positioning, where all moves are made in reference to the zero position; pressing this key selects incremental positioning, where all moves are made the specified distance from the current position.

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Key	Description
	With Lag Finishing. Normally the control will begin executing the next block without waiting for the motor to come into position and take up the lag between the commanded and actual positions. IF it is desired to have the motor in position and stopped before continuing (with Lag finishing), this key is pressed in response to the dialog display WITHOUT LAG? If LF (Line Feed) is pressed instead, the program will continue without waiting for zero lag. (Note all numerical controls have a following error between commanded and actual position based on the gain. Indramat calls this following error, lag.)
	Rapid Traverse. When pressed in response to the dialog display FEEDRATE?, this key selects axis positioning at the rapid traverse rate specified in the system parameters. This key is also used in Hand Mode to select jogging at the rapid jog rate.
	Unconditional (Immediate) Jump. When the Jump Programming function is selected in Dialog Mode, this key can be pressed in response to the BLOCK JUMP? display to specify an immediate jump to a specified block. The block number is then keyed in. The display code is JNXXX.
	Jump To Subroutine. When the Jump Programming function is selected in Dialog Mode, this key can be pressed in response to the BLOCK JUMP? display to specify a jump to a subroutine. The block number is then keyed in. Subroutine programming is described in detail in Section 5.3.15.2. The display code is JUXXX.
	Return. When the Jump Programming function is selected in Dialog Mode, this key can be pressed in response to the BLOCK JUMP? display to specify a return to the main program from a subroutine. The display code is J RETURN.
	Conditional Jump. When the Jump Programming function is selected in Dialog Mode, this key can be pressed in response to the BLOCK JUMP? display to specify a conditional jump. When a conditional jump is executed, a jump is taken depending on the state of the 4 coded conditional jump control lines. Thus, up to 16 different program jumps can be performed, based on an external signal. These could be used to select various part programs stored in memory. The display code is JCXXX BBBB.
	Jump To Block and Stop. When the Jump Programming function is selected in Dialog Mode, this key can be pressed in response to the BLOCK JUMP? dialog display to specify a jump to the specified program block, but the control will stop prior to executing that block. A jump to Block 000 and Stop is required to properly end all control programs. The display code is JSXXX.

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Key	Description
	Reverse Vector Jump. When the Jump Programming function is selected in Dialog Mode, this key can be pressed in response to the BLOCK JUMP? dialog display to specify a new reverse vector to be stored and used when a return or homing procedure is called for. The display code is JRXXX. See the Reverse Vector description, Section 5.3.15.5. Pressing this key in Manual Mode results in the display of the current software version number, as described in Section 4.3.2.

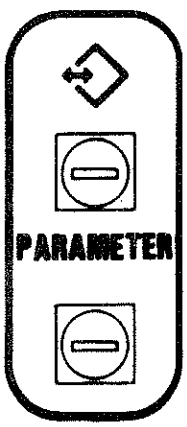
2.6 JOG KEYS

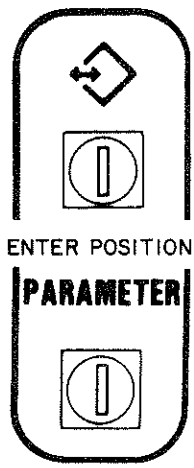
These keys are used for forward and reverse jogging while in Hand Mode. See Section 2.11 for a discussion of operation mode selection.

Key	Description
	Jog Forward. Jogs the slide forward at the current feedrate, or at the rapid jog rate, if selected and enabled. If the overtravel limit switch is reached, a diagnostic message is displayed and this key is deactivated.
	Jog Reverse. Jogs the slide in reverse at the current feedrate, or at the rapid jog rate, if selected and enabled. If the overtravel limit switch is reached, a diagnostic message is displayed and this key is deactivated.

2.7 KEYSWITCHES

Two keyswitches provide a write protect feature for the control. They are:

Key	Description
	Program Entry/Edit Mode Keyswitch. The proper key must be inserted into this keyswitch and turned to the Enter position to enable the entry and editing of programs. When this is done, the control will be switched out of Automatic Mode. Parameter Entry/Edit Mode Keyswitch. The proper key must be inserted into this keyswitch and turned to the Enter position to enable the entry and editing of system parameters. When this is done, the control will be switched out of Automatic Mode.



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2.8 MISCELLANEOUS FUNCTION KEYS

These keys are used to select some percentage of feedrate, to clear errors, to delete data while entering a block, and to properly terminate the entry of a program block.

Key	Description
	Feedrate Override. When this key is pressed, the operator can enter a value from 1 to 100 that represents a percentage of the programmed feedrate and rapid traverse rate. The system will operate under this percentage of maximum feedrate until a new feedrate override percentage is selected. This is often used during setup and toolchange to operate the slide at a slower than normal speed to verify correct operation. This key is not affected by the Program and Parameter keyswitches, and is only active in Manual Mode.
	Store. During programming, the LED indicator on this key lights after all necessary data for the block being programmed has been entered. Pressing this key then transfers the data into memory.
	Clear Error. When an error has been detected during programming, parameter entry, tool correction entry, or during operation, an error message such as FORMAT ERROR is displayed in the alphanumeric display and the LED on this key is lighted. The error will be a Soft Fault, such as a key pressed in an incorrect sequence, and can be cleared by pressing this key. This key must be pressed before the operation or programming can continue. Generally, the data must be re-entered.
	Delete. When this key is pressed,the last key entry is deleted and another entry can be made. This is generally used to correct keying errors. Note that Delete can be used to delete a sequence of keystrokes. For example, if you've selected Edit mode, X line and typed in 10, pressing DEL once deletes the 0; pressing DEL a second time deletes the 1; pressing it the third time deletes the selection of Edit mode.
	Line Feed. This key is pressed to advance to the next line within a block during display, programming and parameter entry/edit. It is also used during programming to skip over a line function within a block that is not desired, such as skipping auxiliary function entry when it is not required in a block.
	Enter. This key is used to enter line data within a block during programming. It is pressed when a certain line function is desired, or after numerical data has been entered.

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2.9 NUMERIC KEYPAD

The numeric keypad includes a pad of keys used to enter parameter, program and tool correction values. These include:

Key	Description
	Data keys. Used to enter information as program commands, parameters and tool corrections are keyed in. Whenever one of these keys is pressed, the corresponding number will be displayed in the position in the command block currently being entered.
	+/- key. Used in incremental motion commands to select motion in the positive or negative direction. Used in absolute positioning commands to select a motion to the plus or minus side of zero. If minus is not specified, plus is assumed.

2.10 POWER INDICATORS

Key	Description
	Power On. Indicates that power to the servo drive is on.
	Power Off. Indicates that power to the servo drive is off. Note that the system controls main power. If everything is correct, the TRANS will operate and some display mode will be selected.

2.11 OPERATION MODE KEYS

The TRANS can be in Automatic Mode or in Manual Mode, as determined by a signal from the Line Control or from the Operator Station. In Manual Mode, the operation mode keys described below are active.

Key	Description
	Continuous Cycle Mode. In this mode, the control will continuously cycle through the program after the Cycle Start key is pressed. This mode is generally used only in set-up and test operations.
	Single Cycle Mode. In this mode, the control will execute one cycle after the Cycle Start key is pressed, or the Start signal is supplied from the Line Control, terminating operation when Jump To Block 000 And Stop is executed. This is the normal operating mode of the control.

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Key	Description
	Single Block Mode. In this mode, one program block is executed each time the Cycle Start key is pressed.
	System Reset. When this key is pressed, a complete clear of the system occurs and all operations halt. Note that this key is disabled during program execution. The position counters are reset and the block counter is reset to block 000, in effect providing the Jump to Block 000 and Stop command that is required to properly terminate a program. This key must be pressed (or the Return signal issued) to clear a Hard Fault (generally a hardware error) and allow restart of the TRANS, once the error has been remedied. The LED on this key will light to indicate that a hard error has occurred. Note that a Homing operation must be executed after the system is reset to once again enable system operations.
	Hand (Jogging) Mode. When this key is pressed, and the TRANS is in Manual Mode, the Jog Forward, Jog Reverse, Rapid Traverse and Auto Home keys are enabled and the axis can be jogged from Manual Mode. Manual Mode must be selected at the Operator Station by the Line Control in order for Hand Mode to be enabled. Only jogging or homing, using the TAM panel keys, can be done in Hand Mode.
	Cycle Start. Pressing this key starts the control when in Continuous Cycle, Single Cycle or Single Block Mode. This will generally be done when testing the system.
	Cycle Stop. Pressing this key causes an immediate stop of program execution.
	Input Data. Pressing this key signals the TAM to accept a TRANS NUMBER from the keyboard, then press (ENTER) to establish communication with the Modular TRANS which is assigned that number on the TRANS-BUS.
	Output Data. Unused in the Modular TRANS-01.

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CHAPTER 3. OPERATING THE TRANS-01 M CONTROL

3.1 GENERAL

As discussed in previous chapters, the TRANS-01 M is designed for operation under control of a remote Line Control (such as a programmable controller) which interfaces to the TRANS via the Cycle Interface. However, various manual operations are necessary And are provided by an Operator Station and the TAM keyboard/display panel.

Access to the TRANS controls, parameters and program is provided at several different levels to provide for maximum security of machine operations. This chapter discusses procedures available at the Operator and Toolsetter levels.

1. The Operator interface to the system is provided by a separate Operator Station, which allows certain manual operations. At this level, access to the TAM is not necessary.

2. At the Toolsetter interface level, the toolsetter will have access to the portable TAM or he will have a key to the TAM 2.01 (fixed TAM) cabinet and can display the current status, can examine the program and parameters, can enter tool corrections, can select feedrate override and can perform manual (program independent) operations (jogging). He can also bypass the Line Control signals to execute the program in Single Block, Single Cycle or Continuous Cycle Modes to verify proper operation. However, he cannot change the program or parameter values without additional keys to enable Program Entry/Edit and Parameter Entry/Edit Modes. Each of the functions listed above is described in Sections 3.3 through 3.10.

3.2 OPERATOR FUNCTIONS

Manual operator controls are available through a parallel operator interface provided by Indramat. The machine builder may wire these signals to selector switches and pushbuttons at the transfer station. Only the normal programmed movements are possible from this station, and they may be made only when the necessary enables are provided on the cycle interface (or serial interface) by the Line Control.

The following functions are provided:

1. Automatic/Manual Modes

   Generally wired to a selector switch. With AUTOMATIC selected, the TRANS will be in Automatic Mode and can be operated only by control signals provided by the Line Control. This is the normal mode of operation, where the TRANS performs a single program cycle each time the Line Control issues a Start signal.

   Manual control at the unit's Operator Station is possible only with the selector switch in the MANUAL position and when the TRANS-01 M diagnostic checking has not detected any interruptions. Should the TRANS refuse to operate, it will diagnose the reason and provide an English-language display on the TAM display panel. See Chapter 8 for a complete list of system diagnostics.

   Note that Manual Mode is distinct from Hand Mode. Manual Mode enables the Forward and Return (Reverse) operations as described below. In addition, Manual Mode must have been selected at the Operator Station or by the Line Control in order for Hand Mode to be selected. Pressing the Hand key on the TAM enables the jogging keys on the panel

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and allows jogging of the axis. The Forward and Return profile operations are not possible from the TAM panel, nor is jogging possible from the Operator Station controls.

2. Forward

Generally wired to a pushbutton. The Automatic/Manual switch must be in the MANUAL position to enable this button. While this button is held depressed, the transfer unit will perform the programmed operation (beginning at block 000), following the programmed forward profile. Releasing the pushbutton stops the movement. Pressing the button again continues the operation.

When first pressed, the FORWARD button will be effective only when the correct program and zero references are present. These beginning conditions can be achieved by pressing the RETURN pushbutton (described below), moving the slide to the Home position.

The Forward program must end with a Jump To Block 000 And Stop. This can be done in one of two ways: either by an immediate jump to the reverse program (normally block 120) or by an absolute move to the home position, followed by a Jump To Block 000 And Stop.

If a block of the Forward program specifies a Reverse Vector Jump of R000, the FORWARD button will execute the program up to and including the block with R000. Program execution will then halt and only the RETURN button will be recognized. R000 serves as a flag to indicate end of the Forward program (in Manual Mode only) and will normally be programmed at the end of the forward profile (full depth). See Section 5.3.15.5 for more information on reverse vector programming.

If the RETURN button is pressed during forward cycle operations, the slide must be homed before the FORWARD button again becomes effective.

Note that at the toolsetter level, the slide can be jogged forward and reverse using the jog keys on the TAM keyboard. In contrast to the action of the FORWARD switch, jogging motion does not follow the programmed profile.

3. Return

Generally wired to a pushbutton. The Automatic/Manual switch must be in the MANUAL position to enable this button. While this button is held depressed, the TRANS will jump to the current reverse vector and perform its reverse operation (as programmed in that block), returning to the Home position. If, previous to the actuation of the RETURN button, program execution was halted by a reverse vector of R000 (as described above), the TRANS will execute the program beginning with the next sequential block after the block containing the R000. See Section 5.3.3 for programming requirements for this operation.

Releasing the pushbutton stops the movement. Pressing the button again continues the operation.

Once the RETURN button has been pressed, the other operator controls are disabled until the slide has returned to the Home position.

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Note that this signal line is labeled "Return" in the TRANS. Depending on the user's design, the pushbutton on the operator panel may be labeled RETURN, REVERSE, etc.

4. Toolchange

Generally wired to a pushbutton. The Automatic/Manual switch must be in the MANUAL position to enable this button. While this button is held depressed, the slide travels to its programmed toolchange position. This will be a position of the slide which provides the proper clearance for tool changing. There are specific requirements for this portion of the program, as described in Section 5.3.4.

Releasing the pushbutton stops the movement. Pressing and holding the button again continues the operation.

When first pressed, the TOOLCHANGE button will only become active if the correct program and zero references are present (control at block zero and homing performed since the last power-up or reset). These beginning conditions can be achieved by pressing the RETURN pushbutton (as described above), moving the slide to the Home position.

3.3 TOOLSETTER FUNCTIONS

The toolsetter can change tools, enter tool correction values into the correction registers and verify system operation. With Manual Mode selected, he can access the various displays to obtain extensive information about the program, such as program status, position, auxiliary functions, etc., to aid him in performing his duties. He can execute program-independent functions in Jogging Mode and bypass the Line Control to execute step and automatic cycles. The necessary interlocks with the Line Control continue to function via the Cycle Interface.

3.4 USING THE TAM

The functions described in the remainder of this chapter are all performed using the TAM keyboard and display. The descriptions assume that a TAM is communicating with a selected TRANS. Establishing that communication is described below.

3.4.1 TRANS Numbers and the TAM

Because the TAM can communicate with any one of several TRANS controls, the operator must specify the TRANS with which to communicate.

Each TRANS in a system is assigned a unique TRANS NUMBER from 01 to 30. The TAM or LCA can then communicate with that TRANS, addressing it by its unique number.

The TRANS NUMBER is a system parameter, selected when the TRANS is installed or replaced. On the modular TRANS, version TRANS-01 M-02 and above, the TRANS NUMBER is selected via switches on the front of the unit, as described in Section 4.2.1.

On version TRANS-01 M-01, the number is selected via an operator procedure, described in Section 4.9. Once the TRANS NUMBER is set, it will seldom need to be changed, except if TRANS memory is lost, such as when a battery is replaced.

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3.4.2 Communicating Using the TAM

The procedure to use the TAM with any TRANS-01 M control is:

1. TAM 2 -- Portable TAM

   a. Connect the serial channel cable from the connector on the front of the TAM to connector X4 or X5 on the selected TRANS, as illustrated in Figure 3-1 below.

   b. This can be done while the TRANS is powered.

   c. The TAM will display: WAITING FOR CONTROL XX.

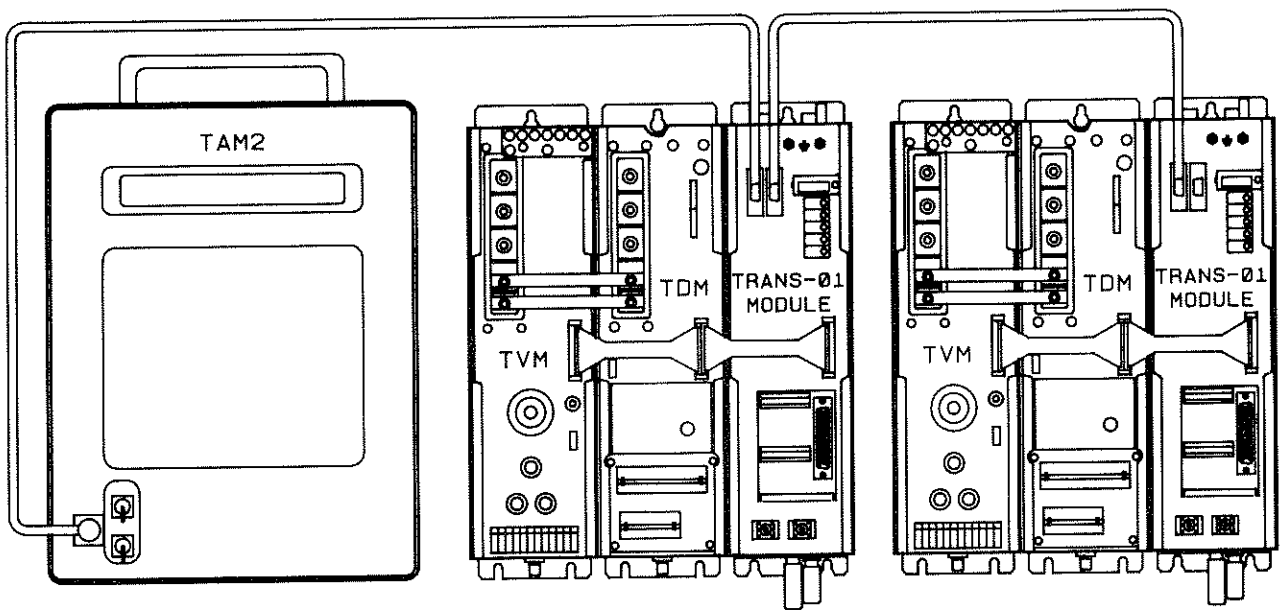


Figure 3-1. Connecting the Portable TAM

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2. TAM 2.01 -- Fixed TAM

   a. The fixed TAM will already be permanently mounted on the machine and may be daisy-chained to up to ten TRANS-01 M modules.

   b. Unlock the cabinet door to access the keyboard.

   c. The TAM may display WAITING FOR CONTROL XX, or may display some other message if a TRANS NUMBER had previously been selected.

** For TRANS-01 M-01 and below, follow procedures 4 - 8.

** For TRANS-01 M-02 and above, follow procedures 3 - 8.

3. For the TRANS-01 M-02, a set of switches is used to set the TRANS-NUMBER in the parameters so that you can communicate with that selected TRANS.

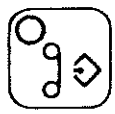
   a. Access these switches by removing the cover plate on the front of the MODULAR TRANS.

   b. The leftmost switch specifies the tens digit. Set it to 1, 2 or 3.

   c. The rightmost switch specifies the ones digit. See it to 1 through 9.

   d. The TRANS-NUMBER is now set in Parameter P00 and cannot be changed from the LCA or the TAM, although it can be examined.

4. Press the Data In key to specify selection of a TRANS for communication.



5. Key in the TRANS-NUMBER of the selected module you wish to access, then press ENTER, as:



6. Using the example above, if WAITING FOR CONTROL 02 remains displayed for several seconds after you've pressed ENTER, modular TRANS 02 is not responding. Refer to the WAITING FOR CONTROL XX diagnostic in Chapter 8 and/or check that the TRANS NUMBER is correctly set (see Section 4.2).

7. When the selected TRANS responds, you will see a message in alphanumeric display of the TAM, appropriate to the condition of that TRANS. This could be a display of the block presently being executed, a status message, a diagnostic message, etc.

   Regardless of the message in the display, the number of the TRANS being accessed will appear in the last two digits of the display. If a long message is being displayed, the last three digits of that message blink on and off, alternating with the TRANS number.

8. When communication is established, the red TAM ACTIVE LED on the selected TRANS will be lighted.

The functions described in the remainder of this chapter are available at the Toolsetter, Program and Parameter levels.

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3.5 DISPLAY FUNCTIONS

Refer to Figure 3-2. This illustrates the top row of keys. While power is on, the control will always be in one of these display modes.

When a TRANS-01 M is first powered up, it will be in Single Cycle Operating Mode and Diagnostic Display Mode. A TAM connected to that TRANS will have the LED's on the Single Cycle and DIAG keys lighted. This is the normal configuration for remote operations.

Various other display and operating modes can be selected from the TAM control panel. The functions of the Display Mode keys are described below.



Figure 3-2. Display Mode Keys

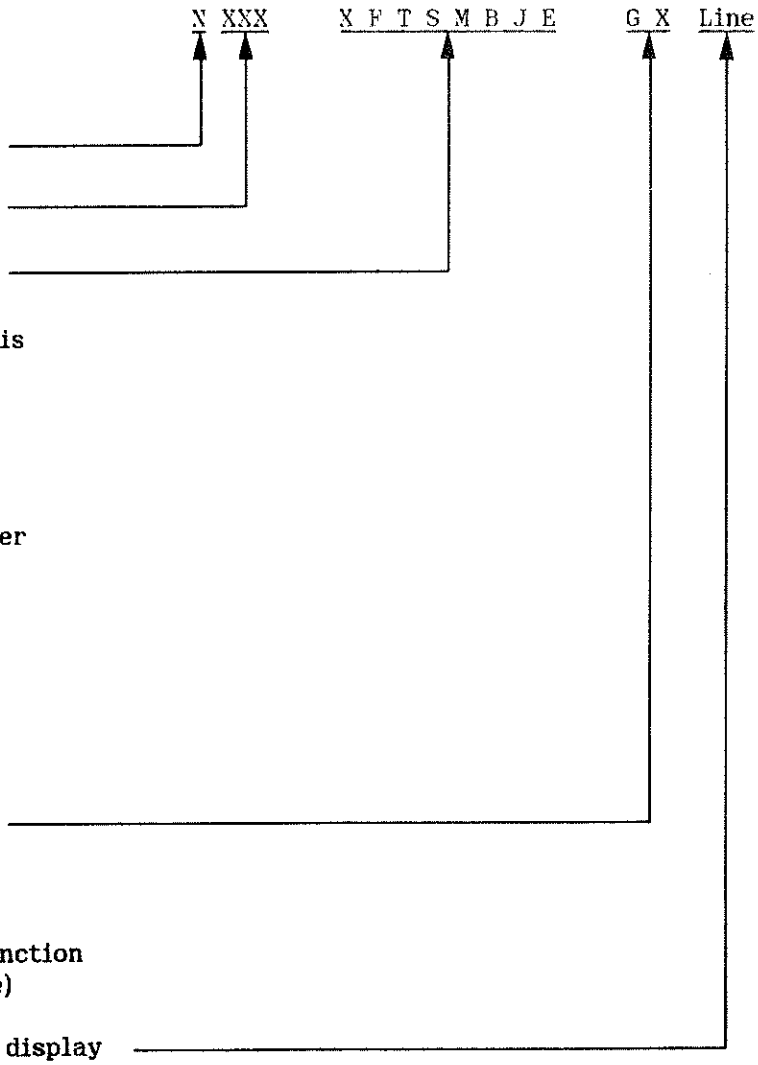
3.5.1 Block Display Mode

Key -



When this key is pressed, the alphanumeric display indicates the functions used in the current block. The display will be as shown on the following page.

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N indicates block

XXX indicates current block number

Summary of contents of block - Presence of a letter indicates the type of information programmed in this block. A "-" appears at a letter position if that function is not programmed in this block.

- X = Position
- F = Feedrate or Dwell Time
- T = Tool Correction Register Number
- S = Analog Spindle Output
- M = Auxiliary Function Outputs
- B = BCD Output Value
- J = Jump
- E = Block Repeat

* A = Feed Adaption Programmed

* D = Idle Detection Programmed

NC G-code, as:

- G0 = Homing
- G1 = Position
- G4 = Dwell
- G5 = Move To Positive Stop/Opt Function
- G6 = Feed Ramp (opt TR32 software)

Line displays - This area is used to display the data programmed in each of the individual lines in the display. The LF (Line Feed) key is pressed to sequentially step through and inspect each line, from X thru 0.

The line displays will be (decimal points appear as appropriate):

Line 1 = X -------	Distance in inches or mm (7 digits).
Line 2 = F ----	Feedrate (inches or mm per min - 5 digits) or Dwell Time (in seconds - 4 digits).
Line 3 = T --	Two digit number of currently selected tool correction register.
Line 4 = S ----	Spindle speed in rpm (4 digits)
Line 5 = M --------	Status of 8 auxiliary output functions. ⊛ = on (⊛ is zero filled with lines) 0 = off
Line 6 = S --	Two digit BCD output value.
Line 7 = J? xxx	Jump, as follows: JN xxx Unconditional Jump to block xxx; JS xxx Jump to block xxx and stop

* Will appear in the display only when the Feed Adaption option is present.

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Line 7 cont'd.	JC xxx 1234	Conditional jump to block xxx based on state of condition lines 1234
	JU xxx	Jump to subroutine at block xxx
	JR xxx	Reverse vector jump to block xxx
	J RETURN	Return from subroutine
Line 8 = E --	Specifies number of times execution of this block will be repeated before the next sequential block is executed.	
Line 9 = A _____	Indicates that feed adaption is programmed in the current block. See Feed Adaption, Section 9.6.4.	
Line 10 = D _____	Indicates that idle detection is programmed in the current block. See Feed Adaption, Section 9.6.4.	

3.5.2 Actual Position Display Mode

Key - 

When this key is pressed, the actual position of the slide (feed Axis) as determined by the encoder-measured position of the motor, the current actual feedrate (feedrate x feedrate override %) and the current status of the auxiliary functions (acknowledgments actually received) are displayed. As the feed axis moves, you will see the actual position changing.

3.5.3 Destination Position Display Mode

Key - 

When this key is pressed, the commanded (destination) position, the current programmed feedrate and the programmed auxiliary function status are displayed. As the slide moves, you will see the commanded position changing.

3.5.4 Deviation Display Mode

Key - 

This key selects a display of the position deviation or lag between the commanded position and the actual position, displayed in inches or mm. As the slide moves, you will see the data change.

The feedrate override, in percent, is also displayed. This indicates the percentage of programmed feedrate or rapid traverse rate at which the control is operating. See Section 3.9 for a discussion of feedrate override selection.

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The existing deviations between the commanded auxiliary functions and their acknowledgments are also displayed. An acknowledgment is required whenever an auxiliary function is turned on or off. If the TRANS stops and displays NO ACKNOWLEDGMENT ON X (where X is the first auxiliary function which is missing a required acknowledgment), you would press this key to determine the area of the problem. A - (dash) indicates that an acknowledgment has been received for an auxiliary output; a * indicates that the required acknowledgment has not yet been received.

3.5.5 Feedrate, BCD Output and Tool Display Mode

Key - 

This key selects a display of the current programmed feedrate, the feedrate override in percent of programmed feedrate, the BCD output value, the current tool correction register number and the current reverse vector.

3.5.6 Diagnostics Mode

Key - 

This is the normal display mode, entered when the TRANS is powered up or reset. The TRANS will be in this display mode when in Automatic Mode, under the control of the Line Control.

In this mode, the current status of the unit will be displayed. This can be a normal status diagnostic, such as NO START, which indicates that the TRANS is awaiting a command from the Line Control; a soft fault diagnostic, such as COMMAND ERROR, which means an incorrect key was pressed; or a hard fault diagnostic, such as ENCODER FAULT, which indicates a disabling hardware problem which must be corrected.

When a soft fault is detected, the LED on the CE (Clear Error) key is lighted. You must press CE, then continue the operation. When a hard fault is detected, the LED on the Reset key is lighted. You must correct the fault, then press Reset and home the axis to continue operations.



3.5.7 Tool Correction Display Mode

Key - 

When this key is pressed, the tool correction register number currently being used in the user program is displayed, along with its value.

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3.6 DISPLAY PROGRAM BLOCKS

Use the following procedure to step through and display the blocks of a program:

1. Generally you will want to select Manual Mode (selected from the Operator Station). Block display can occur while the unit is operating, but you can only examine the various lines within a block while that block is being executed. When execution of the first block is complete, the next block comes up in the display.

2. Press  then press 

3. Type the number of the first block you wish to examine (leading zeros need not be entered), then press 

4. If you make an error while entering the block number, press 

and re-key the number, then press ENTER.

5. The first line of the block is now displayed. Data will appear in the format described in Section 3.5.1.

   A program block can contain up to 10 lines of information. Each time you press LF, you will step to the next line in the current block. 

6. When you wish to examine the next block, press N then LF to advance to the next sequential block number, then successively press LF to step through and examine each line. 



7. Exit from Block Display Mode by selecting any other mode or by pressing (Reset key) to reset the control. 

3.7 DISPLAY PARAMETER VALUES

You can display parameter values form the keyboard at any time in Manual Mode, but these values can be changed only by using the Parameter keyswitch to select Parameter Entry/Edit Mode.

The display procedure is:

1. Switch the control to Manual Mode at the Operator Station.

2. Press 

Parameter P00 and its value are displayed.

3. Each time you press LF (Line Feed), you will advance (scroll forward) the display to the next parameter. 

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Press ENTER to return the display to the previous parameter (scroll backward).



You can display any specific parameter by pressing the N key, keying the parameter number, then pressing Enter. Example:



If a non-existent parameter number is entered, the highest numbered valid parameter is displayed.

See Chapter 4 for a complete list of parameters and their values. Note that some parameters are not used with various software options, so the parameter number will be omitted when scrolling through the display.

4. If you wish to return to the first parameter, press



5. Exit from Parameter Display Mode by selecting any other mode or by pressing (Reset key) to reset the control.



3.8 JOGGING CONTROLS

In Hand Mode, the Toolsetter can jog the slide forward and reverse at either the normal or rapid jog rates. This results in movement of the slide which does not follow the program contour, as opposed to Forward and Return, selected (in Manual Mode) at the Operator Station, which produce slide movement following the programmed contour.

Note that the jogging rates are selected as program parameters.

The procedure for jogging is as follows:

1. Switch the control to Manual Mode at the Operator Station.
2. Press the Hand key.



3. To jog at normal speed, just press either Jog key. The axis will move while the key is being held, and will stop when the key is released.



4. If you jog the slide to one of the hardware overtravel limits, the appropriate diagnostic message (+TRAVEL LIMIT or -TRAVEL LIMIT) is displayed, that jog key is disabled and a soft fault results. At this point, you can jog the slide in the other direction or Home it. Press the CE (Clear Error) key to clear the diagnostic indication. The control will not accept any other commands.

   Note that software travel limits are selected via parameters P10 and P11 (see Chapter 4). These limits are not active until a homing cycle has been performed. Thus, the slide could be jogged past the software limits.

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5. To jog at rapid jog speed, (the TRANS must be homed first) first press the Rapid key. If rapid jog is allowed, the LED on this key will light and the jog keys will be operational. If the slide has not been homed, rapid jogging is not allowed, HOMING MISSING appears in the display and a soft fault results. Press the CE (Clear Error) key to clear the diagnostic indication. Once you have pressed the CE key and homed the slide, rapid jogging can be selected. Press the Rapid key a second time to switch from rapid to normal jogging speed.



6. Exit from Jogging Mode by selecting any other mode or by pressing  (Reset Key) to reset the control.

3.9 SELECTING FEEDRATE OVERRIDE

A feedrate override establishes some percentage of the normal feedrate and rapid traverse rates as the maximum rates for the system. In normal operation, feedrate override would be set at 100%. While changing tools or testing, the operator may wish to select some lower percentage while verifying that the program is correct and the system is functioning normally.

Set the feedrate override as follows:

1. The control must be in Manual Mode and may not be in Program Entry Mode.

2. Press  . (Feedrate Override)

3. Key in the selected percentage feedrate value, between 1 and 100. If you make an error, press DELETE and re-enter the data. If a FORMAT ERROR diagnostic appears (if you attempt to enter 4 digits, for example), press CE to clear the error, then re-key the data.

   If you attempt to enter a value larger than 100, your selection is ignored and the previous override value is retained. The diagnostic RANGE ERROR is issued and a soft fault results. Press the CE key to clear the error, then enter a valid value.

4. Press ENTER to enter the selected feedrate override value into memory.

3.10 ENTERING TOOL CORRECTIONS

The TRANS allows the toolsetter to enter one or more correction (compensation) values to compensate for tool wear or, when changing tools, to compensate for differences between tools. The operating program is written to refer to one of these values by its tool correction register number (from 1 to 20). The correction value in the referenced register is then added to the programmed dimensions to compensate for tool wear or the difference between tools.

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An example of entering a tool correction value is:

1. Examine the program to determine the tool correction register (1-20) being used (see Section 3.5).

2. Set the tool correction value in that register to zero (see description below).

3. Change the tool and run a test part.

4. Measure the part and note the variance.

5. Enter this variance as the tool correction. If the slide did not feed enough (e.g., hole too shallow), program a "+" tool correction value. If the slide fed too much (e.g., hole too deep), program a "-" correction value, assuming parameter P22 is set so that a "+" is into the work piece.

Note that tool correction values can be positive or negative, up to +/- 3.2767 inches (32.767 mm).

Enter tool correction values as follows:

1. Switch the TRANS to Manual Mode at the Operator Station.

2. Press  (Tool Correction Programming Mode)

3. The display will show tool correction register number 1 and its present value, as: T01 XXXXX.

4. If you do not wish to change this value, press LF (Line Feed) to display the next tool correction register number and its value.

   If you wish to display a specific tool correction register number and its value, number 12 for example, press:



5. To change the value, first press the Edit key. 

6. Now key in the desired correction value. If you make an error, press  (Delete) to eliminate it, and re-key the data.

7. When the value is correct, press ENTER. This value is then entered in memory.

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8. To go back to tool correction register number 1, press  then press 

or press 

9. Exit Tool Correction Entry Mode by selecting any other mode or by pressing  (Reset) to reset the control.

After the correction values have been entered, the Toolsetter will usually check out system operation using Continuous or Single Cycle Modes.

3.11 CLEARING FAULTS

There are three types of faults possible in the system.

1. Temporary Fault -- Certain errors, such as I/O SUPPLY MISSING and EMERGENCY STOP are treated by the TRANS as "Temporary Errors." When such a condition is detected, the TRANS halts and displays the appropriate diagnostic message. No other signals will be accepted by the TRANS as long as this condition persists, but no reset of the control is needed once the problem is rectified. At that point, the TRANS will be in an Immediate Stop condition.

2. Soft Fault -- A soft fault, such as a key pressed in the incorrect sequence or an attempt to enter too many digits in a number, results in the FORMAT ERROR, COMMAND ERROR, etc., diagnostic display and the lighting of the LED on the CE key. Correct the fault by pressing CE (Clear Error) and re-keying the data. 

3. Hard Fault -- A hard fault is generally a hardware error of some kind, such as a failure of the encoder, a broken wire, etc. In this case, the position of the slide is no longer known. When this occurs, the appropriate diagnostic message appears in the display and the LED on the Reset key is lighted.
You must remedy the fault, then press the Reset key. The TRANS comes up in Single Cycle Operating Mode and Diagnostic Display Mode. You must now home the axis before operations can continue. 

Faults can be cleared from the Operator Station when in Manual mode. Pressing the RETURN button clears the fault. Releasing the button, then pressing it again causes the TRANS to begin its reverse program. If the cause of the fault has not been remedied, it will reoccur when RETURN is pressed the second time.

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CHAPTER 4. READING/ENTERING SYSTEM PARAMETERS

4.1 GENERAL

The TRANS-01 M is adapted to the machine and drive characteristics by entering values for various parameters. This permits a standard control system to be adapted to various types of drives and incremental encoders which can be chosen to best suit the system requirements. It also insures that all application programs are written with a uniform data format.

Because entry of incorrect data can result in damage to the machine, parameters are entered into the system at the engineering interface level. Access at this level is possible only by using the Parameter key to enable Parameter Entry/Edit Mode. If the system has a TAM 2.01 (fixed TAM), its cover must be unlocked to access the keyboard.

Note that values for all parameters must be entered into the machine before an applications program can be written. The TRANS monitors the parameters and the applications program to assure that all program functions are performed within the constraints established by the system parameters. If a function is programmed or attempted which would exceed the bounds established by these parameters, the control halts and a diagnostic error message is displayed.

This chapter contains a complete list of all parameters and their required formats in both inch and metric dimensioning and a description of procedure for entry of system parameters into the TRANS.

4.2 DISPLAYING AND ENTERING PARAMETERS USING THE TAM AND LCA

4.2.1 Setting Parameter P00 - TRANS Number

A system may have more than one TRANS, therefore each unit must be programmed with its unique TRANS NUMBER (its address on the bus) in parameter P00 before communication can occur. This is a number from 01 to 30 which must be unique for each TRANS control.

Once a TRANS NUMBER is set for a unit, the LCA or TAM can communicate with that TRANS, addressing it by its number.

This procedure is done when the TRANS is installed, then repeated only if the number is changed or memory is lost, such as when a battery is replaced.

Model TRANS-01 M02

A set of switches is used to set the TRANS NUMBER in controls of Version TRANS-01 M02 and above.

1. Access these switches by removing the cover plate on the front of the modular TRANS, as illustrated in Figure 4-1.

2. The left most switch specifies the tens digit. Set it to 1, 2 or 3.

3. The right switch specifies the ones digit. Set it to 1 through 9.

4. The TRANS NUMBER is now set in parameter P00 and cannot be changed from the LCA or the TAM, although it can be examined.

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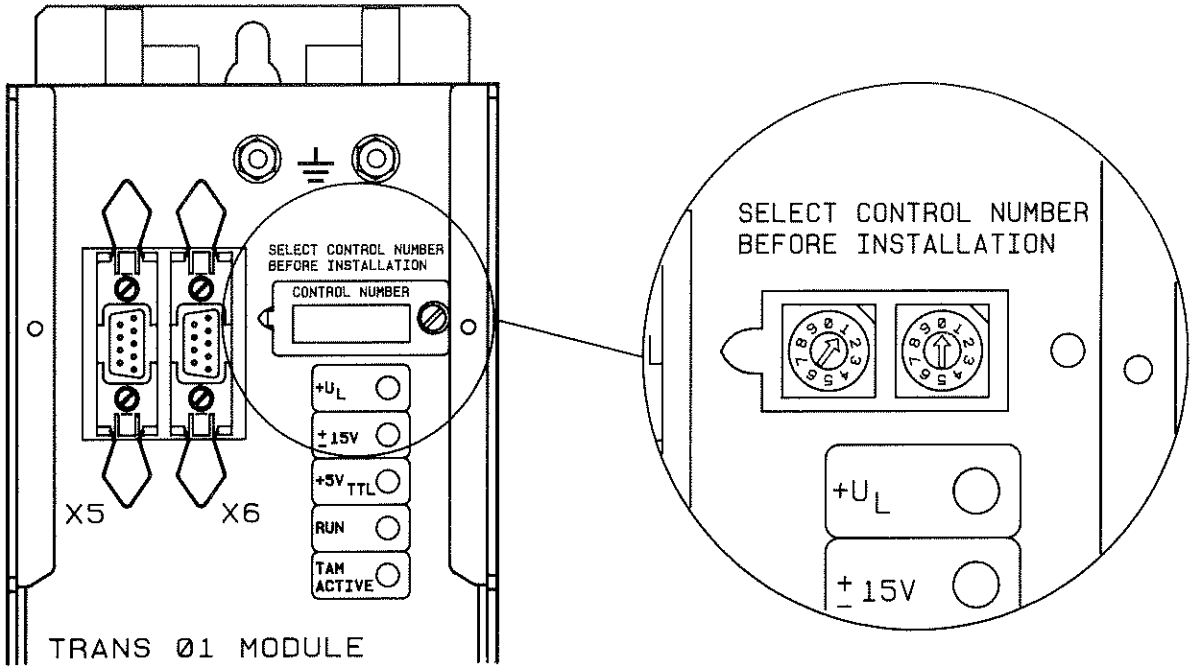


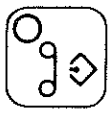
Figure 4-1. TRANS NUMBER Switches

5. Replace the cover.

6. We suggest that you label this unit with its TRANS NUMBER for easy reference in the future.

4.2.2 Parameter Display/Entry/Edit Using A TAM

1. Make sure a TAM is connected to the selected TRANS as described in Section 3.4. It will display: WAITING FOR CONTROL XX.

2. Press the Data In key. 

3. Key in the TRANS-NUMBER of the TRANS-01 M module you wish to access, then press ENTER. Example: 

4. When the selected TRANS responds, you will see a message in the alpha-numeric display of the TAM, appropriate to the condition of that TRANS. This could be a display of the block presently being executed, a status message, a diagnostic message, etc.

   Regardless of the message in the display, the number of the TRANS being accessed will appear in the last two digits of the display. If a long message is being displayed, the last three digits of that message blink on and off, alternating with the TRANS number.

5. When communication is established, the red TAM ACTIVE LED on the selected TRANS will be lighted. You can now display, enter or edit parameters as described in the following paragraphs.

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4.2.3 Parameter Display/Entry/Edit Using an LCA

You must use the TAM to set up TRANS parameter P00 to specify the TRANS NUMBER. You may then use the LCA to communicate with the TRANS.

Refer to Indramat document IA 74708 for complete details on installation and use of the LCA.

4.3 DISPLAY PARAMETER VALUES

4.3.1 Parameter Display

You can display parameter values from the TAM at anytime in Manual Mode, but these values can only be changed by using the Parameter keyswitch to select Parameter Entry/Edit Mode.

The display procedure is:

1. Switch the control to Manual Mode at the Operator Station.

2. Press 

. (Parameter Entry/Review Mode).

   Parameter P00 and its value are displayed.

3. Press LF (Line Feed) to advance the display to the next higher valid parameter.



   Press ENTER if you wish to return the display to the previous valid parameter.



   Any specific parameter can be displayed by pressing the N key followed by the parameter number, then the ENTER key. Example:



   If a non-existent parameter number is entered, the highest numbered valid parameter is displayed.

4. If you wish to return to the first parameter, press 

(Delete)

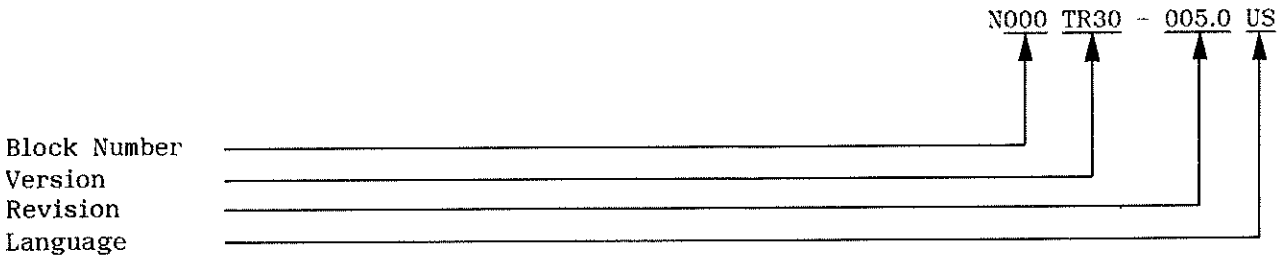
5. Exit Parameter Display Mode by selecting any other mode, or by pressing  (Reset) to reset the control.

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4.3.2 Software Revision Level Display

Some of the parameters discussed in this chapter are not available on all versions of TRANS executive software, depending on what features are available. To determine what parameters are available on a specific TRANS, the type of executive software installed in it must be known. This may be found in one of two ways: either by checking the Software Version label on the front panel of the TRANS; or by pressing the REV key on the TAM while in Manual Mode, which will cause the version number to be displayed as illustrated below.

The software version number will be displayed as:



US = English
D = German
I = Italian
F = French
S = Swedish

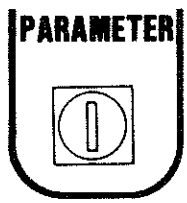
4.4 PARAMETER ENTRY

Enter or review TRANS Parameters as follows:

1. Switch the control to Manual Mode at the Operator Station.

2. Establish communication between your TAM and the selected TRANS as described in Section 3.4.

3. Insert the correct key into the Parameter keyswitch and turn it to Parameter Entry/Edit Mode.



4. Parameter P00 and its present value will be displayed. This is the TRANS NUMBER. You cannot change the displayed value, so press LF (Line Feed) to advance the display to the next parameter.

5. To change a displayed parameter, press the Edit key, then key in the revised value. If you make a typing error, press DEL to delete it, and re-key the information. Note that leading and trailing zeros need not be typed.



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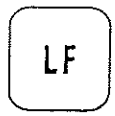
If you attempt to enter too many digits or a decimal point where one isn't allowed, FORMAT ERROR is displayed and a soft fault results. Press CE to clear the error, then re-enter the value.

If the keyswitch is not in Parameter Entry/Edit Mode when Edit is pressed, WRITE PROTECTED will appear in the display.

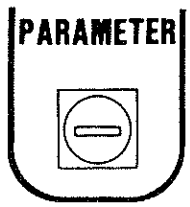
5. When satisfied with the new value, press ENTER to enter the parameter value into memory. If this value is greater than the limiting value for that parameter (see table in Section 4.7), the value will be rejected, RANGE ERROR will be displayed and a soft error will result.



6. Press LF (Line Feed) to advance the display to the next valid parameter, or press ENTER to return the display to the previous parameter.



7. Continue this parameter entry procedure from step 4 until the desired number of parameters have been set or edited. Then turn the keyswitch back to its locked position and remove the key.



At this point, the entire parameter set is checked for interrelationships, such as selected rapid speed excessive for a given available motor RPM. If the selected parameters cannot be used together, UNACCEPTABLE PARAMETERS is displayed and a soft error results. See Section 4.6 for more details on error checking and a description of recommended recover procedures.

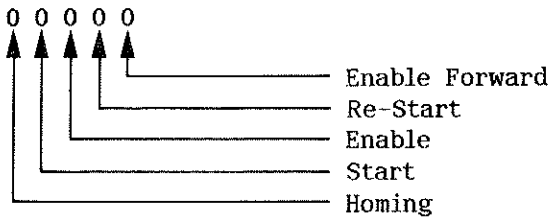
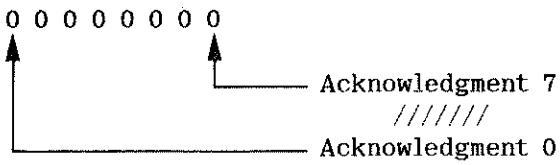
8. Press RESET to reset the control. You are now ready to enter an application program, as described in Chapter 5.



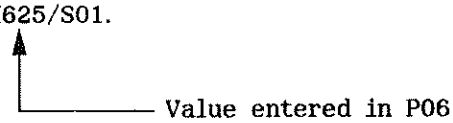
Note that the Parameter keyswitch can be used to select Parameter Entry/Edit Mode while the system is operating, although this is not recommended. In this case, the drive immediately shuts off, the PARAMETER MODE diagnostic is displayed and a hard fault occurs. See Section 3.11 for a discussion of the procedure for clearing faults.

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4.5 TRANS-01 M PARAMETER LIST

Parameter Number	Description	Format Inch	Format Metric
P00	TRANS-NUMBER -- Specifies the address of the TRANS control on the TRANS-BUS. See Section 4.2.1 for information on the setting of this parameter.	XX	XX
P01	TRANS-GROUP NUMBER -- Specifies a "group" the TRANS will be a part of for LCA global commands in binary format. Enter a number from 1 to 9.	X	X
P02	SERIAL CYCLE INPUTS -- This parameter determines from where the TRANS will accept its cycle interface commands -- either the TRANS-BUS or connector X11. Using the key below, enter a "1" to accept the command from the serial TRANS-BUS; "0" to select the normal input at connector X11.  	See description.	
P03	SERIAL ACKN-INPUTS -- Specifies from where the TRANS will expect auxiliary function acknowledgments, and is programmed as P02 above. Enter a "1" to accept acknowledgments from the TRANS-BUS; "0" to accept them from connector X8.  	See description.	
P04	SERIAL CONDITIONS -- Specifies from where the TRANS will accept conditional jump inputs which are used in making block jump decisions during program execution. There are four conditional jump inputs on the TRANS. Either a "0" or a "1" may be entered for this parameter. A "0" causes the conditional jump inputs to be accepted from the parallel input lines located on connector X11. A "1" causes them to be accepted from the TRANS-BUS, ignoring the inputs on X11.	X	X
P05	UNITS -- Enter 0 to select metric; 1 to select inch.	X	X

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Parameter Number	Description	Format Inch	Format Metric
P06	ENCODER CYCLES/REV -- Enter number of encoder (lines) per revolution for Indramat "Style 1" feedback assemblies. This number can be found on the motor name-plate; e.g., MAC 132 A0ED/85-0/I625/S01.  For other styles of feedback assemblies, (e.g., "Style 4" WIxxx packages): Refer to the support documentation for that package to determine the encoder cycles/rev. The Indramat Product Type Code Manual, Publication IA 74711, contains a list of Style 4 encoder specifications.	XXXX	XXXX
P07	BALLSCREW LEAD (All except Rotary software option -- Enter as distance per revolution. If a rack and pinion drive train is used, multiply the pitch diameter of the pinion by pi (3.1415926) and enter the result.	XX.XXXXX	XXX.XXXX
P07	UNITS/TABLE REV (Rotary software option, TR33) -- This parameter determined how many "display-programming" units one revolution of the drive train output (e.g., table) will be divided into. Any value between 10 and 1000 may be set into this parameter, with three decimal place precision (e.g., 10.000 to 1000.000). Speeds in both parameters and programs are expressed in units/table rev/min. For example, if programming in degrees is desired, this parameter would be 360. Programming as well as position display would then be in degrees, with a resolution down to 0.001 degrees. Speeds would be in degrees/-minute. This parameter is limited by the bit weight of the system (see parameter limits). For convenient interpretation of table position, the TAM display modes present position as a value between 0 and this parameter value. Each time the display reaches this parameter value, it resets to zero and begins counting up again. For negative movements, passing zero causes the display to roll over and begin counting down from this parameter value.	XXXX.XXX	XXXX.XXX

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Parameter Number	Description	Format Inch	Format Metric
P08	GEARBOX REV IN -- Enter actual number of input turns corresponding to the number of output turns, which is specified below. Thus, any non-real gear ratio, such as 142:6 can be entered.	XXXX	XXXX
P09	GEARBOX REV OUT -- Enter actual number of output turns as described for Gearbox Rev In.	XXXX	XXXX
P10	+ TRAVEL LIMIT -- Enter software travel limit on the plus side of home. This parameter will prevent axis overtravel in the plus direction. Physical travel limit switches may also be present and will be physically positioned beyond the programmed software travel limits, in most cases. The control includes provisions for sensing hardware overtravel and will halt and issue a diagnostic error message if a hardware overtravel occurs. See the caution in P12, on the following page.	XXX.XXXX	XXXX.XXX
P11	- TRAVEL LIMIT -- Enter software travel limit on the minus side of home. See comment above.	XXX.XXXX	XXXX.XXX
	CAUTION 1. Software travel limits must be programmed in relation to the actual reference position (Home). They are not affected by the zero reference setting or by zero offset. 2. Software travel limits are not active until a homing cycle has been performed. Thus, the axis could be manually jogged (via the panel controls) past the software limits.		
P12	REFERENCE POSITION -- In many cases, some position other than the home position, such as the center line of the slide, is used as the reference position. All programmed distances are then specified in reference to this point. Enter either 0 or the distance from home to the reference position into this parameter. (Refer to Figure 7-7, page 7-14.) When the TRANS is homed, this value is loaded into the counters, and all moves are made in reference to this position. Thus, if the reference position was +3 inches and the slide was at home, an absolute move to +1 inch would result in a 2 inch move in the negative direction.	XXX.XXX	XXXX.XXX

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Parameter Number	Description	Format Inch	Format Metric
P13	MOTOR RPM/10 VOLTS -- This is a specification of the drive, and is entered in RPM. For TDM, DSC and KDS controllers, refer to the "MOD X" personality module value specified for E1/E2.	XXXX	XXXX
P14	KV FACTOR -- This is the position gain of the system. Enter in inches/min/mil (ipm/.001") or meters/min/mm. This is the following error expressed in units of velocity. Standard KV factor = 1.0/ Entering a larger number will yield a "tighter" system, but entering too large a number can result in oscillation and sporadic faults.	X.X	X.X
P15	HOMING SPEED -- Specifies the speed at which the axis will be homed when reference position (Home) is not known (i.e. after power-up or reset), or when no feedrate value is entered in a homing function block. This can be the same as the rapid traverse rate, but can also be any other value. In some cases, homing may occur under different conditions than rapid traverse, and a different feedrate may be required. Note that homing must be programmed as described in Section 5.3.3.	XXXX.X	XXXXX
P16	RAPID SPEED -- Specifies the rate at which the axis will be moved when rapid traverse is specified and feedrate override is set at 100%. This parameter is the limit for all feedrates in the user program.	XXXX.X	XXXXX
P17	JOGGING SPEED -- Speed at which normal jogging (commanded using the TAM jog keys) will occur.	XXXX.X	XXXXX
P18	JOGGING RAPID -- Speed at which rapid jogging (commanded using the TAM keys) will occur when it is selected and enabled. The axis must have been homed for rapid jogging to be enabled.	XXXX.X	XXXXX
P19	RAMP -- The system acceleration is limited only by the system gain (KV Factor - P14) up to the maximum feedrate (parameter P20 below). Above maximum feedrate it operates under a controlled acceleration ramp specified in this parameter. This limits system acceleration at high speeds to avoid excessive mechanical strains. Enter in in/sec/sec or mm/sec/sec.	XXX.X	XXXX

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Parameter Number	Description	Format Inch	Format Metric
P20	MAX FEEDRATE -- Maximum feedrate which will be encountered in the part program. Above this speed, the acceleration ramp (parameter P19) will be activated. Below this speed, the KV factor (parameter 14) is the only acceleration limit.	XXXX.X	XXXXX
P21	RETRACT -- When Cycle Stop is pressed in Manual Mode or when an auxiliary function acknowledgment is lost while executing the user program, the axis will reverse from its present position by the amount specified in this parameter prior to the immediate stop. This function could be useful in the case when it is desired to move the tool away from the part when not feeding (tool relief).	XXX.XXXX	XXXX.XXX
P22	DIRECTION POLARITY -- Reverses the direction of rotation for a given plus and minus command. Allows wiring all slides up the same way, compensating for the presence or absence of a gearbox by providing direction reversal in software. 0 = negative; 1 = positive. Set this parameter as follows: 1. Select Hand Mode and jog the axis in a given direction. 2. If the position display does not show the desired polarity (e.g., display indicates - (minus) when advancing the axis and + (plus) is desired), change this parameter to the opposite of its present value.	X	X
P23	HOMING DIRECTION -- Reverses the direction in which the control searches for the Home Limit switch. 0 = search in plus direction when the switch is open (usually into the part); 1 = search in minus direction (usually away from the part). Minus is normally chosen as the homing direction.	X	X
P24	JOGGING DIRECTION -- Reverses the direction in which the axis will move when the jog keys on the TAM are used.	X	X

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Parameter Number	Description	Format Inch	Format Metric
P25	MAX FEEDRATE FOR G5 -- This is the maximum feedrate which can be programmed when using the Feed-To-Positive Stop function (G5) or other option, such as Adaptive Depth Control (see Chapter 9). A soft fault results if an attempt is made to program a higher feedrate than this parameter-specified maximum in a block using one of these function.	XXXX.X	XXXXX
P26	% TORQUE TO POS STOP -- This is the percentage (01-100) of maximum motor torque that will be available while feeding to a positive stop using the Feed-To-Positive Stop function (G5).	XXX	XXX
P27	% TORQUE AT POS STOP -- This is the percentage (01-100) of maximum motor torque that will be available while stalled at a positive stop, when using the Feed-To-Positive Stop function (G5).	XXX	XXX
P28	AUX OUTP AT EM STOP -- This parameter can be used to force the level of the auxiliary function outputs whenever an emergency stop occurs (see Section 6.9). This can be useful in situations where some functions must be interrupted if an emergency stop occurs. Eight positions are available in this parameter, corresponding to auxiliary function outputs 1 to 7. P P P P P P P P aux output 7 ////// aux output 0 Programming a "0" forces the corresponding output off during an emergency stop regardless of previous status; a "1" forces it on. Skipping over a position using either the LF or DEL keys causes that output to remain at the level it was before the emergency stop occurred (indicated by a "dash" in the display). Once an E-stop occurs, the outputs will assume the levels programmed here.	See description	

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Parameter Number	Description	Format Inch	Format Metric
P28 (Cont'd)	When the emergency stop condition is removed, program execution may be resumed, provided the following sequence is performed: 1. Before a restart is issued, the acknowledgements for each output must match the conditions those outputs assumed when the emergency stop occurred. 2. Restart may then be issued and the outputs will revert to the levels they were at before the emergency stop occurred. 3. The acknowledgments must again be set to match the output status, after which program execution will continue. Note that when an emergency stop occurs, the TRANS treats it as both an emergency stop and an immediate stop. If any outputs force condition specified in this parameter conflicts with those given in P29, the level in P29 will take precedence while the Emergency Stop signal is low. When Emergency Stop is brought high, the values in P29 will be assumed until an action (Restart, Homing, etc.) is commanded.		
P29	AUX OUTP AT IM STOP -- Used to force the levels of auxiliary function outputs when an immediate stop condition occurs. Immediate stop is the condition assumed by the TRANS when a soft fault occurs, or in Manual mode when a Forward, Return or Tool change cycle has been initiated but interrupted before completion by bringing the corresponding input low. This parameter is programmed similarly to P28 above.	See description.	

NOTE: The parameters described below on the following pages will be present in the TRANS software only when the option they pertain to is present in the system.

P30	NOM CURRENT (A) (Feed Adaption Option, software TR34) -- This parameter specifies the continuous current rating for the motor whose current is measured for feed adaption. This could be either the spindle or axis motor. After this value is entered, any references to motor current encountered in programming or in diagnostic displays will be expressed in a percentage of this parameter value.	XXX	XXX

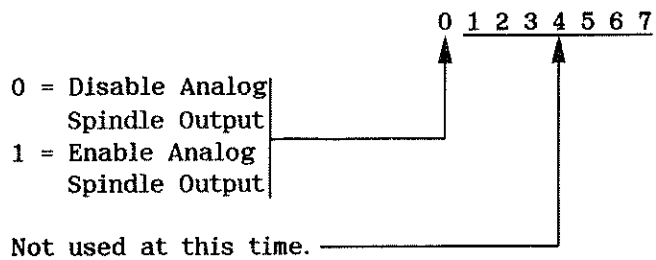
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Parameter Number	Description	Format Inch	Format Metric
P30 (Cont'd)	To find the value to be entered here, first determine if the TRANS is measuring current from an Indramat spindle drive, or a standard induction motor. If an Indramat spindle drive is used, the value may be found on the nameplate of the induction motor, or on the controller personality module in the case of a MAC spindle drive. If another manufacturer's induction motor is used, refer to that manufacturer's specifications. The minimum value for this parameter is 25; the maximum value is 200. See Section 9.5 for a description of the Feed Adaption option and discussion of the use of this parameter.		
P31	MAX NO THR-CURRENT (Feed Adaption Option, software TR34) -- This parameter defines the maximum no-thrust (idle) current that the system may have. No-thrust current is the motor current required during a non-cutting condition. This parameter is entered as 00-99% of the current rating entered in parameter P30. See Section 9.5 for a description of the Feed Adaption option and the use of the parameter.	XX	XX
P32	LIN-ENC-RESOLUTION (Adaptive Depth Control Option, software TR35) -- This parameter pertains to a linear encoder and specifies the linear distance per linear encoder line. Note that the encoder provides 4 pulses per line. Thus, an encoder with 2.5 micros per pulse has 10 microns per line. Enter in inches or mm per line.	X.XXXXX	XX.XXXX
P33	LIN-ENCODER-DIRECTION (Adaptive Depth Control Option, software TR35) -- Coordinates the linear deflection with slide direction. A "0" indicates that positive motion (as programmed into the TRANS) will cause increased deflection of the linear encoder. A "1" indicates that minus motion increased deflection of the linear encoder.	X	X

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Parameter Number	Description	Format Inch	Format Metric
P34	MAX LIN-ENC-DEFL (Adaptive Depth Control Option, software TF35) -- This parameter specifies the maximum possible deflection of the linear encoder. This value is determined by the full-stroke limit of the linear encoder used, less any pre-deflection present in the mechanical linkage. Enter in inches or mm. If an attempt is made to program an adaptive depth block with a "LIN DESTINATION" value higher than the value specified by this parameter, a Range Error will occur.	XXX.XXXX	XXXX.XXX
P35	LIN-ENCODER PRE-LIMIT (Adaptive Depth Control Option, software TR35) -- Sets the maximum amount of deflection the linear encoder may have while the motors encoder is active (normal positioning). The value of P33 will determine if this parameter is positive (P33=0) or negative (P34=1). This parameter can be used to indicate part mislocation. Enter in inches or mm.	XXX.XXXX	XXXX.XXX
P36	FEED RAMP (software TR32) -- Provides for a acceleration ramp (see P19, RAMP) which can be utilized in the feed speed range. When FEED RAMP is selected in Dialog programming (see Section 9.6), the value programmed in this parameter specifies the system acceleration for that block in all speed ranges. Enter in in/sec/sec or mm/sec/sec.	XXX.X	XXXX
P37	SPINDLE DIRECTION (Analog Spindle Output Option, software TR30-004.0 and above) -- This parameter determines the direction of spindle rotation for a given program command (+ or -). It may be 1 or 0. When used with Indramat AC Spindle Drives, entering a 0 causes the motor to rotate CCW (as viewed from the output shaft) for a programmed positive spindle speed. For direct drive spindle applications, this would yield the normal tool rotation required for positive speed values. Entering a 1 produces CW rotation for a programmed spindle speed. This would be the normal value for a spindle with gearing such that tool rotation is opposite motor rotation. Technical note: For a programmed + spindle speed, a 0 produces a negative analog command, a 1 produces a positive analog command.	X	X

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Parameter Number	Description	Format Inch	Format Metric
P38	SPINDLE RPM/10 VOLTS (Analog Spindle Output Option, software TR30-004.0 and above) -- This parameter is a specification of the spindle controller, and is entered in RPM. Refer to the appropriate spindle controller user's manual for information on determining this value. For example, if an Indramat KDA/CDM AC Spindle Drive is being used, this value would be the same as that entered for the "MAXIMUM RPM" parameter in the CDM. This parameter is the maximum programmable spindle RPM in the part program. If the programmed value is larger than this parameter value, the output speed command voltage is limited to 10 volts.	XXXX	XXXX
P39	MAXIMUM CORRECTION (Analog Spindle Output Option, software TR30-004.0 and above) -- This parameter limits the maximum programmable values for tool correction. This parameter is valid for both manual correction values and the external correction value. Entering correction values larger than this maximum results in an immediate stop condition in the part program at the point where the correction value was to be used. The CORRECTION EXCEEDED diagnostic message is displayed. This parameter is not included in the Rotary Table Option software (TR33).	X.XXXX	XX.XXX
P40	OPERATION MODE 1 (Analog Spindle Output Option, software TR30-004.0 and above) -- This parameter allows the selection of 8 basic program functions, as illustrated below.  It is advisable to enter the parameters first, then enter the part program because a change in this parameter results in the current TRANS program becoming invalid.	See description.	

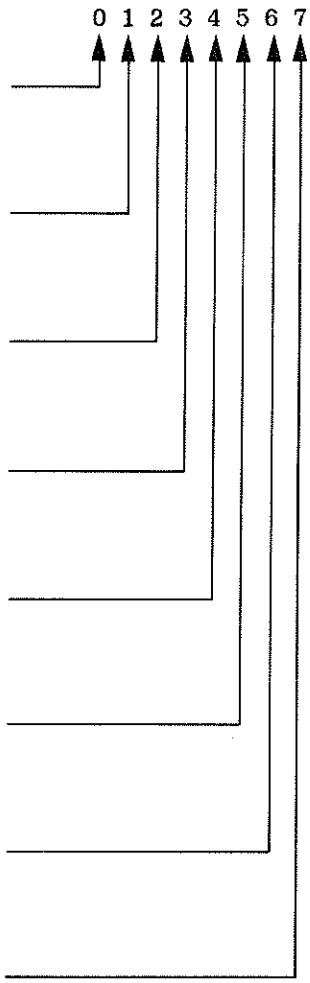
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Parameter Number	Description	
P40 (Cont'd)	For example: If a parameter digit is changed and an exit is made from parameter mode (by turning the keyswitch), the "Program Invalid" diagnostic message is displayed. The programmer now has the option to 1) re-enter parameter mode and change to the previous setting (by turning the parameter key on, pressing the Reset key and changing to the original parameter setting) or 2) reset the current program and enter a new part program. NOTE: After initial parameters are entered and the TRANS is successfully started up, a change of these parameter digits without changing the TRANS wiring could result in damage to the TRANS control, the servo controller or both.	
P41	OPERATION MODE 2 (Analog Spindle Output Option, software TR30-004.0 and above) -- This parameter allows the selection of 8 special functions without the necessity of rewriting the part program. However, great care should be taken to ensure that the parameters are programmed to correspond to the physical manner in which the TRANS in interconnected to the machine. Failure to program the parameters correctly will result in the malfunction of the control and/or servo controller and in incorrect fault diagnostic messages.	See description

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Parameter Number | Description

Function selection is illustrated on the below.



P41 (Cont'd)

Immediate Stop for Spindle
0 = Continuous Spindle Rotation
1 = With Commanded Stop

Home Switch Monitoring
0 = Active
1 = Inactive

Control Type
0 = TRANS 01 M02 or higher
1 = TRANS 01 M00 or M01

External Correction Value Input
0 = Not Selected
1 = Selected

Type of Corrective Move
Absolute = 0
Incremental = 1

Tach Sensitivity
0 = 3V/1000 RPM
1 = 1.5V/1000 RPM

Auto/Manual Function Switching
0 = Always Possible
1 = Only Possible After Cycle Stop

Unused

By default, all digits of this parameter are initially set to "0".

Bit 0 - Immediate Stop For Spindle

Setting this bit to "0" selects a continuous spindle output from the TRANS during an immediate stop condition, whereby the spindle motor would continue to run under power.

Setting this bit to a "1" selects a commanded immediate stop output, whereby the spindle motor is commanded to stop immediately during an immediate stop stop condition. In addition, after a restart, the TRANS will wait until the spindle is at speed before continuing execution of the part program.

An immediate stop occurs after any interruption:
emergency stop, soft fault, hard fault, etc.

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Parameter Number	Description
P41 (Cont'd)	Bit 1 - Home Switch Monitoring

In certain applications, the Home Limit switch is mounted on the motor shaft rather than in a linear plane, hence it is actuated more than once in the same direction. In this situation, the home switch monitoring function will continuously detect the HOME SWITCH ERROR fault.

Setting this bit to a "0" activates the monitoring function. Setting this bit to a "1" deactivates the monitoring function.

Note: When the monitoring function is inactive, the TRANS will execute an initial homing procedure every time homing (G0 function) is commanded. Thus, after the TRANS has been powered up and homing is commanded, the slide will move at the speed specified in the homing speed parameter (P15).

For Rotary Table Option software (version TR33), the home switch monitoring function is inactive and programming of this digit is not necessary.

Bit 2 - Control Type

This parameter matches the TRANS hardware version being used with the executive software. Versions TRANS 01M-02 and above contain hardware improvements and require a "0" programmed in this bit. For versions TRANS-01M-00 and -01, this bit must be set to a "1".

Bit 3 - External Correction Value Input

A "1" in this bit allows the acceptance of external correction values by the TRANS; a "0" disables this function. The necessary hardware expansion module is needed to accept the values sent from the correction device. Also, TRANS auxiliary functions 6 and 7 are reserved for the high byte and low byte acknowledgments being sent to the TRANS.

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Parameter Number	Description
P41 (Cont'd)	Bit 4 - Incremental Correction Input

With a PEA installed in a TRANS-01 M, correction values that are either absolute (replace current correction register contents) or incremental (summed with current correction register contents) can be sent. This bit selects that feature.

0 = External Correction values are absolute
1 = External Correction values are incremental

The status of this bit is ignored if bit 3 of this parameter is '0' (External Correction Input disabled). If however, no PEA is installed, 'UNACCEPTABLE PARAMETERS' will result as with bit 3.

Bit 5 - Tach Sensitivity

This bit specifies the motor's tach sensitivity. The standard tach sensitivity for Indramat MAC servomotors is 3V/1000 RPM; however, rare earth magnet servomotors such as the MAC 63, 71, 93, 115, etc., have a tach sensitivity of 1.5V/1000 RPM.

Typical Indramat MAC motor tach sensitivity selected by this bit is:

"0" = 3V/1000 RPM -- MAC motors with closed loop operational speeds of 3000 RPM or less.

"1" = 1.5V/1000 RPM -- MAC motors with closed loop operational speeds above 3000 RPM.

Note: The above is an Indramat standard for MAC servomotors and does not reflect special applications.

This digit must be correctly programmed for the type of servomotor used in your system. If it is not, sporadic DRIVE FAULT, TACH FAULT, and/or ENCODER FAULT diagnostics may occur.

Bit 6 - Auto/Manual Function Switching

A "0" programmed in this bit selects normal monitoring of the Auto/Manual switch. A "1" in this bit specifies that the switch to Manual Mode will be ignored until a program stop has occurred. This is typically at the end of the part program cycle or when the cycle has been interrupted by an Immediate Stop or Emergency Stop signal.

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4.6 PARAMETER ERROR CHECKING

The TRANS checks for parameter errors at three different points during parameter entry. These three different types of error checking are:

1. Format Check

As parameters are being keyed in, they are checked for correct format, such as correct number of digits keyed. FORMAT ERROR is displayed if an incorrect format is used for a parameter. Press CE to clear this diagnostic, then re-enter the parameter value.

2. Range Check

When you press the ENTER key to enter a parameter into memory, that parameter value is checked to determine that it is within the acceptable range, as defined in Section 4.7 below. If the value is out of range, RANGE ERROR is displayed. Press CE to clear this diagnostic, then re-enter the parameter value.

3. Unacceptable Parameter Check

When all parameters have been entered and the Parameter Entry/Edit Mode keyswitch is returned to its normal position, the TRANS executes a set of limit formulas to determine if it can physically operate within the specified parameter set. Section 4.8 lists the limit formulas used. If an unacceptable parameter is found, execution stops and UNACCEPTABLE PARAMETERS appears in the diagnostic display.

This calculation is necessary because two parameters may each individually be within range, but the effect of their interaction may be out of range of the system's physical capabilities.

If this diagnostic appears, correct the problem as follows:

1. Insert the correct key into the Parameter Keyswitch and turn it to the Parameter Entry/Edit Mode.

2. Press the CE (Clear Error) key. The unacceptable parameter will be displayed.

3. Refer to the limit formulas in Section 4.8 and determine a corrected value for the parameter.

CAUTION

> Check your entire parameter set before making any corrections. The TRANS checks the parameters in order, starting with P00. The parameter you are correcting is the first unacceptable parameter, not necessarily the only one and not necessarily even the erroneous parameter. For example, assume you have a 2000 RPM motor (Parameter P13), but enter 200 in error. This is a low value, but within range, so is accepted by the control. In parameter P16, you select a rapid speed of 300 inches/min, well within range for that parameter. However, when you exit Parameter Entry/Edit Mode, the TRANS indicates P16 as an unacceptable parameter. It is unacceptable, but because P13 is incorrect.

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4. Press Edit, then key in the revised parameter value. If you make a typing error, press DEL to delete it, then re-key the information.



5. When satisfied with the new value, press ENTER to enter the parameter value into memory.

6. Successively press LF (Line Feed) to advance the display if you wish to change another parameter. Repeat from step 4 above.

7. When all corrections have been made, turn the keyswitch back to its normal position and remove the key.

8. Press the Reset key to reset the control. The TRANS again checks the set of limit formulas. If UNACCEPTABLE PARAMETERS is again displayed, repeat this procedure. Otherwise, enter an applications program as described in Chapter 5.



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4.7 PARAMETER VALUE LIMITS

Table 4-1 below summarizes the maximum and minimum values which can be entered for each of the parameters.

TABLE 4-1. PARAMETER VALUE LIMITS

No.	Parameter	Minimum	Maximum	Units
P00	TRANS-NUMBER	1	30	---
P01	TRANS-GROUP NUMBER	1	9	---
P02	SERIAL CYCLE INPUTS	00000	11111	---
P03	SERIAL ACKN-INPUTS	00000000	11111111	---
P04	SERIAL CONDITIONS	0	1	---
P05	UNITS	0	1	---
P06	ENCODER CYCLES/REV	100	9999	cycles (lines)/rev.
P07	BALLSCREW LEAD	0.10000	83.80000	inches
		1.0000	838.0000	mm
P07	UNITS/TABLE REV	10.000	1000.000	---
P08	GEARBOX REV IN	1	9999	revolutions
P09	GEARBOX REV OUT	1	9999	revolutions
P10	+ TRAVEL LIMIT	0.0000	838.8600	inches
		0.000	8388.600	mm
P11	- TRAVEL LIMIT	-0.0001	-838.8600	inches
		-0.001	-8388.600	mm
P12	REFERENCE POSITION	-838.8600	838.8600	inches
		-8388.600	8388.600	mm
P13	MOTOR RPM/10 VOLTS	100	9999	RPM
P14	KV FACTOR	0.5	5.0	ipm/mil
		0.5	5.0	m/min per mm
P15	HOMING SPEED	0.1	6500.00	inches/min
		1	65000	mm/min
P16	RAPID SPEED	0.1	19600.0	inches/min
		1	196000	mm/min
P17	JOGGING SPEED	0.0	6500.0	inches/min
		0	65000	mm/min
P18	JOGGING RAPID	0.0	6500.0	inches/min
		0	65000	mm/min
P19	RAMP	0.0	999.9	inches/sec/sec
		0	9999	mm/sec/sec
P20	MAX FEEDRATE	0.0	3276.7	inches/min
		0	32767	mm/min
P21	RETRACT	0.0000	2.0000	inches
		0.000	20.000	mm
P22	DIRECTION POLARITY	0	1	---
P23	HOMING DIRECTION	0	1	---
P24	JOGGING DIRECTION	0	1	---
P25	MAX FEEDRATE FOR G5	0.1	3276.7	inches/min
		1	32767	mm/min
P26	% TORQUE TO POS STOP	1	100	percent
P27	% TORQUE AT POS STOP	1	100	percent
P28	AUX OUTP AT EM STOP	00000000	11111111	---
P29	AUX OUTP AT IM STOP	00000000	11111111	---

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TABLE 4-1. PARAMETER VALUE LIMITS (Cont'd.)

No.	Parameter	Minimum	Maximum	Units
P30	NOM CURRENT (A)	25	200	amps
P31	MAC NO THR-CURRENT	1	99	percent
P32	LIN-ENC-RESOLUTION	0.00001	0.01000	inches/line
		0.0001	0.1000	mm/line
P33	LIN-ENCODER DIRECTION	0	1	---
P34	MAX LIN-ENC-DEFL	0.0000	838.8600	inches
		0.000	8388.600	mm
P35	LIN-ENCODER PRE-LIMIT	-838.8600	838.8600	inches
		-8388.600	8388.600	mm
P36	FEED RAMP	0.1	999.9	inches/sec/sec
		1	9999	mm/sec/sec
P37	SPINDLE DIRECTION	0	1	---
P38	SPINDLE RPM/10 VOLTS	100	9999	RPM
P39	MAXIMUM CORRECTION	0.0	3.2767	inches
		0	32.767	mm
P40	OPERATION MODE 1	00000000	11111111	---
P41	OPERATION MODE 2	00000000	11111111	---

4.8 PARAMETER LIMIT FORMULAS

As previously described, the TRANS parameters are checked for interaction according to the set of formulas listed below.

To work with these formulas, first calculate values for the operating variables listed below:

X0 = 10000 when P05 = 1 (inch mode)
X0 = 1000 when P05 = 0 (metric mode)

X1 = (P07 * P09 * X0)/P08

X2 = X1/(4 * P06) = Resolution*

$$X3 = \frac{1.597806 * 10\ 10\ X\ P14}{X1 * P13}$$

X4 = (P07 * P13 * P09 * X0)/(P08 * 1000)

* The resolution is in units of 10^{-4} inches/pulse or 10^{-6} meters/pulse and is the positioning accuracy of the system.

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TABLE 4-2. PARAMETER LIMIT FORMULAS

No.	Parameter	Limit Formulas
P06	Encoder Cycles/Rev	0.0625 <= X2 <= 1024 Note: The bit-weight (resolution), which is the positioning accuracy of the system, can be derived using the formula for X2; eliminating the value for X0 when calculating the value of X1 (which is part of the formula for X2).
P07	Ballscrew Lead	4 < X1 < 33554432
P10	+ Travel Limit	0.0000 inch <= P10 <= X2 * 838.8600, when X2 < 1 0.0000 inch <= P10 <= 838.8600, when X2 >= 1 0.000 mm <= P10 <= X2 * 8388.600, when X2 < 1 0.000 mm <= P10 <= 8388.600, when X2 >= 1
P11	- Travel Limit	X2 * (-838.8600) inch <= P11 <= -0.0001, when X2 <1 -838.8600 inch <=P11 <= -0.0001, when X2 >= 1 X2 * (-8388.600) mm <= P11 <= -0.001, when X2 < 1 -8388.600 mm <= P11 <= -0.001, when X2 >= 1
P12	Reference Position	X2 * (-838.8600) inch <= P12 <= X2 * 838.8600 when X2 < 1 (-838.8600) inch <= P12 <= 838.8600, when X2 >= 1 X2 * (-8388.600) mm <= P12 <= X2 * 8388.600, when X2 < 1 (-8388.600) mm <= P12 <= 8388.600, when X2 >= 1
P13	Motor RPM/10 Volts	P13 <= 8388608 * 1000/X1
P14	KV Factor	1 <= X3 <= 65535
P15	Homing Speed	P15 <= X4 * 1000/X0 and P15 <= 65000 * 1000/X0 and P15 <= P16
P16	Rapid Speed	P16 <= X4 * 1000/X0 and P16 <= 196000 * 1000/X0
P17	Jogging Speed	P17 <= X4 * 1000/X0 and P17 <= 65000 * 1000/X0 and P17 <= P16
P18	Jogging Rapid	P18 <= X4 * 1000/X0 and P18 <= 65000 * 1000/X0 and P18 <= P16
P20	Max Feedrate	P20 <= X4 * 1000/X0 and P20 <= 32767 * 1000/X0 and P20 <= P16
P25	Max Feedrate for G5	P25 <= X4 * 1000/X0 and P25 <= 32767 * 1000/X0 and P25 <= P16

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4.9 SETTING TRANS NUMBER - VERSIONS TRANS-01 M00 AND M01

Versions M00 and M01 do not have switches for setup of the TRANS NUMBER, thus the following procedure must be used:

1. First make sure that you have a TAM connected only to the control you are going to set. If a number of controls are daisy-chained, you will need to interrupt the chain, so the TAM is communicating only to the one you wish to set.

2. The TAM should be displaying "WAITING FOR CONTROL XX", where XX scrolls from 01 to 30.

3. Press the Data In key.



4. Key in the number zero and press ENTER.

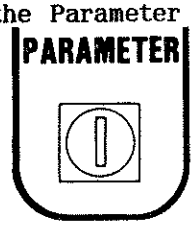


5. The TRANS is now responding as unit 00 and parameters can be set. Unit 00 is a valid number for use only in TRANS set-up. It cannot be used as a working TRANS number.

   The diagnostic message PROGRAM INVALID or PARAMETER INVALID should appear, and the first two digits of the display will flash 00.

   If you are using new software in an older TRANS, some other diagnostic message, such as ENCODER LAMP FAULT, may appear. In that case, you will need to change parameter P41 before you can select the TRANS NUMBER, as described in step 9 below.

6. Use the Parameter key to turn the Parameter keyswitch to the Parameter Entry/Edit mode.



7. Press RESET.

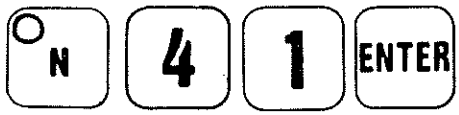


8. Parameter P00 and its present value will be displayed.

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9. Press the Edit key. If NOO NOT CHANGEABLE is displayed, you will need to change parameter P41, as described below. Otherwise, skip to step 10.

   a. Select parameter P41, by typing the following sequence:



   b. Press EDIT to display the present value of P41.

   c. Retype the value for P41, changing bit 2 from a 0 to a 1.

   d. Press ENTER. This is a flag to let the new software know that it is running in an older version TRANS.

10. Press the Edit key, then key in the TRANS NUMBER selected for this unit. If you make a typing error, press DEL to delete it and re-key the number.

11. Press ENTER to enter the TRANS NUMBER into memory.

12. We suggest that you label this unit with its TRANS NUMBER for ease of reference in the future.

13. Now you can enter the other parameters for this TRANS, following the procedure in Section 4.4.

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CHAPTER 5. PROGRAMMING

5.1 GENERAL

5.1.1 Enabling Program Changes

Because it is important to protect the part program from accidental or unauthorized alterations, program changes must be enabled as follows:

1. Fixed TAM (TAM 2.01) -- Unlock the panel cover.

2. Portable TAM (TAM 2) -- Connect the serial cable from the TAM to the selected TRANS.

3. Establish communication between the TAM and the selected TRANS, as described in Section 3.4.

4. Insert the Program key in the Program Entry/Edit keyswitch and turn to enable Program Entry/Edit Mode.

5.1.2 Contents of this Chapter

This chapter contains:

1. A discussion of required programming formats for each type of function which can be selected.

2. A description of the procedures required for entry of each possible type of program line.

3. A set of flow charts which present the programming information in a handy graphic form.

4. Examples of typical part programs.

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5.2 FUNCTIONS WHICH CAN BE PROGRAMMED

The TRANS has 128 blocks which can be programmed. Any of the following functions can be programmed in each block.

NC CODE	FUNCTION
G0	Homing
G1	Position command - either absolute or incremental positioning
G4	Dwell time
G5	Feed to a positive stop / or optional function
F	Feedrate
T	Tool correction register number to be used
S	Analog spindle RPM output (Analog spindle output must be enabled in Parameter P41)
M	Auxiliary functions
B	BCD output
E	Block repeats
J	Program jumps

- J N -- Unconditional jump
- J U -- Jump to subroutine
- J R -- Reverse vector programming
- J S -- Jump and stop
- J C -- Conditional jump (based on 4 input lines)
- J RETURN -- Return from subroutine

Feed ramp, feed adaption and idle detection can also be programmed, provided the appropriate software option is present in the system. See Chapter 9 for details on these options, including instructions for programming.

5.3 APPLICATION PROGRAMMING REQUIREMENTS

Remote operation of the TRANS-01 M via the Cycle and Operator Interfaces requires that certain rules for machining, reverse movements and tool change programs must be established and scrupulously observed by the programmer.

This is necessary to insure that program execution will always be started in the proper manner, independent of unexpected events and actions, and that the system will always remain controllable in all operating situations via the Operator and Cycle Interfaces.

If these programming rules are not obeyed, the TRANS will, depending on the type of violation, refuse to issue a Ready signal for the start of automatic operation, or it will not be possible to execute a homing command or manual operation selected from the Operator Station.

The various programming situations and the requirements for each are summarized in following sections.

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5.3.1 Start of the Program

All machining programs must start with block 000. If several different machining programs are to be written, branching must be accomplished such that an unconditional or conditional jump from block 000 will be executed to jump to the start of the program.

First Positioning

In order to assure that machining programs will be executed with a correct absolute reference under all circumstances, the first positioning in a machining program must be programmed in Absolute Positioning Mode, i.e., under no circumstances in Incremental Mode.

5.3.2 End of the Program

All programs must be terminated with a Jump To Block 000 And Stop command.

This applies equally to machining programs, reverse programs, and tool change programs.

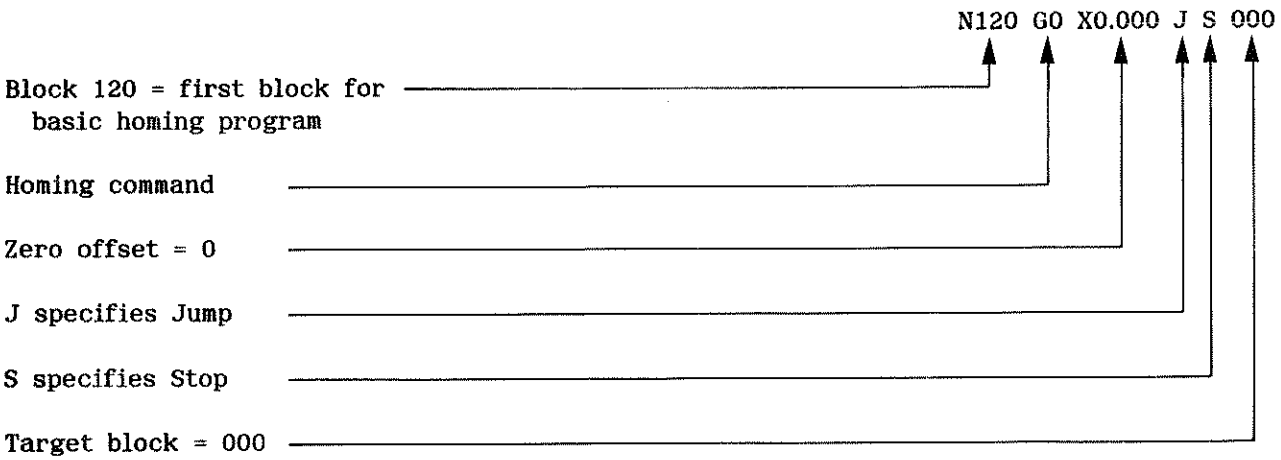
5.3.3 Basic Homing Program

A homing program for travel to the reference position is required at block 120. It must conform to the following requirements:

1. No instruction for travel to a particular position is permitted if there is no prior instruction for homing.

2. The program must always contain a Homing instruction.

3. The program must always be terminated with a Jump To Block 000 And Stop instruction. The simplest such program following block 120 is, therefore, Homing with a Jump to Block 000 and Stop.



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The homing program must be designed so that safe retraction is possible under any condition, including power shutdown. To insure this, the TRANS has been provided with "reverse vectors" which will determine the block number to which the program will jump if a reverse command is issued, both in Operator (manual) and Automatic modes. The reverse vector is initially set to block 120, but can be changed to any block number in the machining program. Each time the TRANS executes a Jump To Block 000 And Stop, the reverse vector is reset to 120. The reverse vector number is retained even if a power failure occurs.

As described in Section 5.3.13, auxiliary outputs can be issued at various points in the program and the TRANS waits for an acknowledgment for each output turned on or off before it executes the next block. The one exception to this is that a jump to a reverse program is performed even if the acknowledgments do not match their associated outputs, provided that the first block of that program performs only auxiliary output functions. (This is useful for an emergency return or upon recovery from a power failure.)

This first block in the reverse program (usually 120) should force the auxiliary outputs into a state where they match their acknowledgments. The next block then will usually be a homing command. This should only be performed if it is indeed safe to force auxiliary outputs off and move.

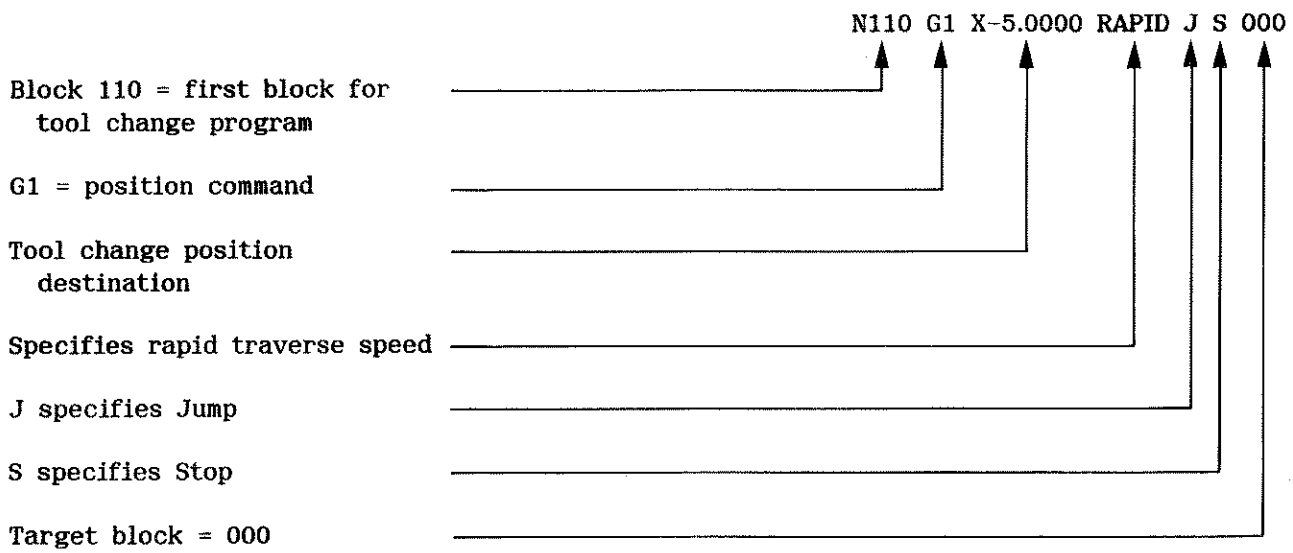
Reverse vector programming is described in Section 5.3.15.5. An example of reverse vector programming is presented in Programming Examples, Section 5.7.

5.3.4 Tool Change Program

Pressing the toolchange key at the Operator Station initiates the toolchange program starting at block 110.

In order to start the machining cycle directly from the toolchange position, the program must be terminated with a Jump To Block 000 And Stop.

The simplest such program for travel to the toolchange position, starting with block 110, is therefore:



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5.3.5 Homing and Zero Offset (NC Code G0)

When Homing is selected during dialog programming, the TAM will display ZERO OFFSET?

Note that a reference value is entered as system parameter P12. This reference value is used to establish the machine reference point as some point other than home, such as the center point of the slide. If all references to the part are to be programmed with respect to this machine reference point, a zero offset value of 0 must be entered.

However, if the measurements in the program are to be programmed with respect to some other reference, such as the face of the workpiece, the distance from the machine reference point to the workpiece reference point is entered as the zero offset, providing a new reference point which is offset some specified distance from the machine reference point.

The value entered as zero offset is added to the reference position after homing has occurred. Thus, the zero offset can be used by the programmer in order to program the measurements in a machining program with respect to one of the surfaces of the work piece.

In order to assure correct measuring references, programs which use zero offset referenced measurements must be started with a homing instruction which sets the corresponding zero offset.

Note that the control is at home when the slide is at the position where the first marker pulse (zero pulse) occurs after closure of the Home Limit switch.

The zero offset provides the flexibility to change the reference point whenever a different part is handled on the transfer line, or to correct differences between actual and designed home position.

5.3.6 Positioning (NC Code G1)

Two types of positioning can be selected in the system, absolute and incremental. In absolute positioning, all movements of the slide are made to some absolute distance from the machine reference position, which will either be home or some offset position from home. Thus, if the slide is at +2 inches from home, a command to travel to +3 inches results in a one inch feed in the positive direction.

In incremental positioning, all movements of the slide are made in the commanded direction to the distance specified, starting from the current position of the slide. Thus, if the slide is at +2 inches from home, a command to travel +3 inches incrementally results in the slide positioned at +5 inches from home.

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5.3.7 Lag Finishing During Positioning

When a position command is issued, the servomotor moves the axis in response to that command. There will always be some finite lag time between the time the command is issued and the time the servomotor brings the axis into position.

When programming your positioning commands, you will be required to respond to the "Without Lag?" display, which is an abbreviation for Without Lag Finishing.

Lag finishing specifies that the axis must be stopped in position before any miscellaneous functions remaining in the block are executed or before the next block is executed. This would be required at full depth, for example. It is important to note that this is also required where you have programmed miscellaneous functions, such as auxiliary outputs (Section 5.3.13), which are to turn on only when the axis is in position. Lag finishing is selected by pressing the  (Lag Finishing) key.

If a lag during positioning is acceptable (lag finishing not required), you press the Line Feed key instead of the Lag Finishing key. In this case, the position lag from one block will not be completed before the next block or the miscellaneous functions in the current block are executed.

It is important to note that, in a program block, the TRANS does the positioning first, then performs any miscellaneous functions, such as jumps or turning auxiliary functions on or off when it finishes the movement. If you select without lag finishing, the movement is considered to be finished once the axis is moving into position but prior to the time the position is actually reached. Thus, any auxiliary functions in this block or the next block may be turned on while the axis is still in motion.

Therefore, lag finishing may not be necessary to your positioning operation, but you may need to select it to insure that auxiliary functions are not turned on too soon.

5.3.8 Feedrate (NC Code F)

In order to enable position commands, a feedrate must be programmed. A programmed feedrate remains valid until a new one is set. Thus, it is not necessary to program a feedrate for a position command if a valid feedrate has previously been programmed. However, it is good practice to always enter a feedrate in a block, unless program operation dictates a block without a feedrate.

NOTE

When checking the feedrate, always check the feedrate override also. The programmed feedrate is effective only to the selected percentage of feedrate override, i.e., programmed feedrate is effective only if the feedrate override is set to 100%.

5.3.9 Dwell (NC Code G4)

A dwell is programmed to allow time for some action to occur, such as a dwell programmed after a forward cutting motion to allow a drill to clean the borehole and prevent burrs.

Dwell times can be programmed from 0.01 to 99.99 seconds.

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5.3.10 Feed To Positive Stop (NC Code G5)

This function may be used when it is necessary to position the slide against a positive mechanical stop. The slide will move at the feedrate programmed in this block. The available torque of the motor will be reduced to the percentage value specified in parameter P26, "% Torque To Pos Stop." When the TRANS senses that the motor has stalled; the motor's available torque will be changed to the percentage value programmed in parameter P27, "% Torque At Pos Stop." This torque value will be used for any Dwell or other waiting period, e.g., auxiliary function acknowledgments. The torque value will be switched back to 100% torque at the time the next movement is begun.

An incremental distance programmed in a block following a feed-to-positive-stop will be based on that point where the stall occurred. The distance (incremental) or destination (absolute) programmed with this function is the maximum distance the slide will be allowed to travel and should be a point just past the expected positive stop. If the slide reaches this position without the motor stalling, movement will stop, the diagnostic POS STOP MISSING will be displayed and a soft fault will result. To recover, you must press the CE (Clear Error) key and perform a homing function.

5.3.11 Tool Corrections (NC Code T)

The TRANS includes a feature which allows programmed corrections to be entered to compensate for changes in the tool or part dimensions.

Tool corrections are effective only when programmed together with a position command.

Program entry is in a two digit tool correction register, which has an associated correction (or compensation) value. Twenty tool correction registers are available. Correction values are entered as described in Section 3.10, Entering Tool Corrections.

When the TRANS is operating, the correction value in the specified tool correction register is added to the programmed position value, i.e., the target position of the TRANS is the sum of the programmed position and the correction value. Once a correction register is specified in a block, it remains valid for all subsequent moves until a different tool correction register is specified in a position command or until the control is reset.

Zero setting of the tool correction value is accomplished by specifying tool correction register 00 in a position command.

Tool correction values are entered at the Toolsetter level, and only access to the TAM keyboard is needed. The program Entry and Parameter Entry keys are not required. This design allows the entry of corrections by the Toolsetter without the danger of inadvertently changing the program.

5.3.12 Analog Spindle Output (NC Code S)

This function is programmed for a TRANS which is controlling a spindle axis. You enter the actual speed in rpm at which you want the spindle to operate. The TRANS then sends an analog command voltage to the spindle controller to generate that speed.

The commanded spindle speed is effective until changed in another program block. Thus, if you do not program a spindle speed of zero in your homing block, the spindle will continue to run at the last commanded speed.

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Unlike the TRANS-01, the Modular TRANS allows both analog spindle output and feed to positive stop to be active simultaneously.

Note that several parameters affect spindle operation.

1. Bit 0 of Parameter P40 enables or disables analog spindle output.

2. Bit 0 of Parameter P41 determines whether or not the spindle will halt when an Immediate Stop occurs.

A number of operating signals are returned by the spindle controller, as described in Chapter 6. If a spindle fault is diagnosed, the TRANS halts and the appropriate diagnostic message is displayed on the TAM. See Chapter 8 for a list of diagnostic messages.

5.3.13 Auxiliary Functions (NC Code M)

Eight auxiliary function outputs are available in the system. They are used to operate position dependent functions such as solenoids, switches, clamps, full depth indicators, lights that must be turned on dependent on a position, etc.

Auxiliary functions can be turned on or off by entering a 0 or 1 in the proper command positions. When an auxiliary function is selected, it is turned on or off at the completion of the G-code (movement or dwell).

An acknowledgment is required for each auxiliary function. When the command is executed, the TRANS awaits the acknowledgments for any functions which were turned on or off before it executes the next block. During this wait, the TAM displays the diagnostic message NO ACKNOWLEDGMENT ON X, where X is the first missing auxiliary function number (0 - 7).

Once an acknowledgment is issued, the signal line must be held in that state until the function output changes. If not, program execution halts and a soft fault occurs.

There is one important exception to the above. The TRANS allows a jump to the reverse program to be performed even if the acknowledgments do not match their associated auxiliary outputs. This can occur on an emergency return or upon recovery from a power failure. In this case, in the first block of the homing program it is necessary to insure that all auxiliary outputs are forced into a state where they match their acknowledgments. The easiest way to do this is to program the first block of the reverse program (usually 120) to turn off all auxiliary functions and program the next block with a homing function. Assuming all acknowledgments will also be off then, homing will always be possible. When programming this, of course, it must be certain that axis movement is possible and safe with all outputs off.

Section 6.10 provides a functional description of auxiliary outputs/acknowledgments and presents line control interface guidelines for the system designer.

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5.3.14 BCD Output (NC Code B)

Eight BCD outputs are available on the TRANS. They can be turned on and off in BCD (Binary Coded Decimal) format within a machining program. These outputs can be used to signal certain positions to another control or display panel, to control auxiliary equipment, etc. A two digit code (00 - 99) is entered into the block line, and the corresponding outputs will be turned on or off after the completion of the main block function. Refer to Section 6.11 for additional information on BCD outputs.

5.3.15 Program Jumps

Several types of program jumps are available, as discussed in the following paragraphs. If program jumps have been selected in a block together with other functions, their execution will occur at the end of the block, after all other functions have been executed.

5.3.15.1 Unconditional Jump (NC Code JN)

An unconditional jump transfers control to another block number anywhere in the program. This allows the programmer to change the sequence of program execution. It is helpful when patching programs. The required new program section can be written into some available block locations and tied to the original program by an unconditional jump instruction. A jump instruction at the end of the new program section transfers control back to the original program.

In addition, a jump instruction can be used to fulfill the requirement that all machining programs must start with block 000, even if the first block 000 will contain a jump instruction which transfers program control to the corresponding program starting block.

Note that jumps may point only to blocks which contain valid program instructions, otherwise the TRANS will respond with the diagnostic error message JUMP TO GAP.

5.3.15.2 Jump to a Subroutine (NC Code JU)

Programs which contain identical program sequences in two or more places can be simplified by designating these identical sections as subroutines or subprograms). These subroutines can be executed (called) from the main program by executing a Jump To Subroutine instruction.

When the Jump To Subroutine occurs, the TRANS transfers program execution to the block number specified in the Jump instruction while storing the number of the block which initiated the jump to subroutine. When the TRANS encounters a Return instruction in the subroutine sequence, it returns program control to the main program block from which it executed the Jump To Subroutine instruction. Program execution then continues with the next block.

A Jump To Subroutine can be executed from any point in the main program and a return to that point is assured after completion of the subroutine.

J Jump To Subroutine must jump to a valid block or the error diagnostic JUMP TO GAP will occur.

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Subroutines are programmed just like main programs. Note, however, that a subroutine must always contain a J RETURN instruction as its last entry. However, a Return may not appear in a program which has not been declared as a subroutine, because this would confuse the program sequence. In such a case, the TRANS responds with the diagnostic message RETURN ILLEGAL.

5.3.15.3 Conditional Jump (NC Code JC)

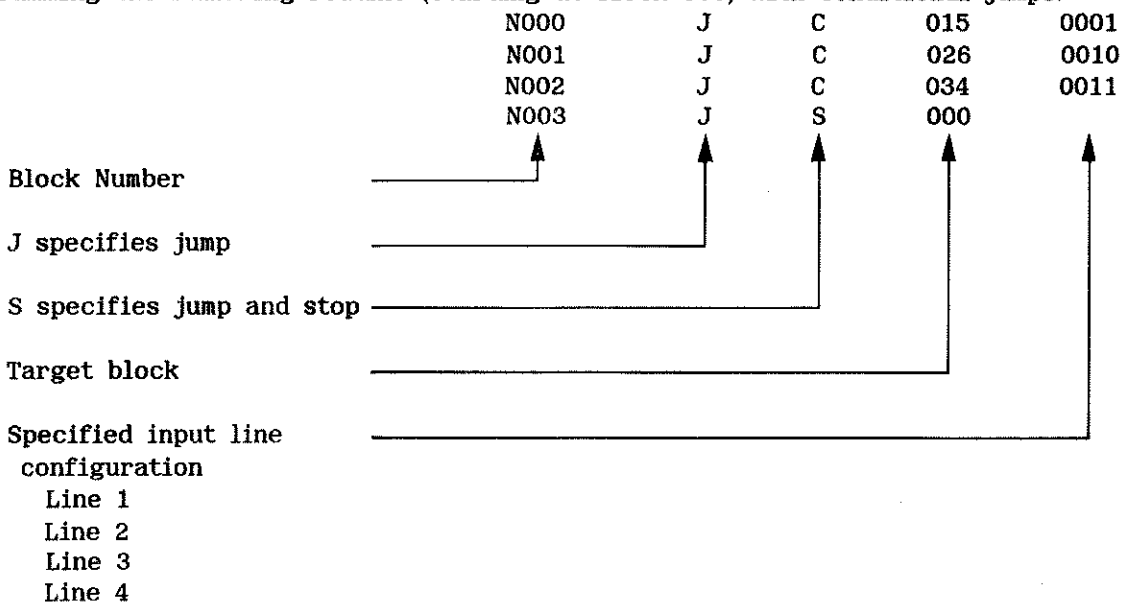
A conditional jump transfers program control to the specified block number only if the programmed condition exists on the four conditional jump control inputs. These are user interface inputs, allowing the user to determine via external signals (such as selector switch inputs) whether a programmed jump should be executed.

Example:

Assume the TRANS has three different programs which start at the following block numbers:

Program 1 --- Block 015
Program 2 --- Block 026
Program 3 --- Block 034

One of these three programs can be executed, based on the position of a selector switch, by programming the following routine (starting at block 000) with conditional jumps.



In the above example, the program starting at block 015 is executed when line 4 of the selector switch is high and all others are low. The program at block 026 is executed when line 3 of the selector switch is high and all others are low; and the program at block 034 is executed when lines 3 and 4 are high and all others are low.

Block 003 is programmed with a Jump To Block 000 And Stop. In the case where the selector switch has an invalid input combination, this will cause the program to return to the beginning and stop, rather than proceeding in an uncontrolled manner.

Note that conditional jumps may point only to blocks which contain valid program instructions. Otherwise, the TRANS will respond to the jump command with the diagnostic message JUMP TO GAP.

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5.3.15.4 Jump And Stop (NC Code J5)

The Jump And Stop instruction causes an unconditional jump to the target block and subsequent stop of the program without execution of that target block. Continuation of the program occurs only after a renewed Start signal is issued.

This instruction is used mainly at the end of a machining program, where a Jump To Block 000 And Stop instruction is required. Jump And Stop can also be used at other positions in a program, if it is desirable to continue the program only after a renewed state.

5.3.15.5 Reverse Vector (NC Code JR)

When an executing user program is interrupted with a Return signal, and the axis is to be returned to the home position, it is often necessary to execute different program sequences depending on the status of the user program at the time the Return signal was received. For example, if the tool is in the part, your Return (Reverse) program may be different than if the tool were at the face of the workpiece.

This situation may occur in slide units, both during manual operation, when the Return input is triggered, and during automatic operation when the Homing input is triggered.

A special type of jump command, the Reverse Vector Jump, specifies with which block the Return program is to start when a Return or Homing signal is issued.

The reverse vector is set to block 120 when the TRANS is reset and is reset to block 120 each time the TRANS executes a Jump To Block 000 And Stop (jump to beginning of program). As previously described, block 120 is the beginning location for the basic homing program. At any point in the forward program you can use the Reverse Vector Jump command to set some block other than 120 as the start of your Return (Reverse) program.

A starting point programmed in this manner will remain effective until it is replaced by a new reverse vector of the same type executed in your program. This allows coordination of very complicated Return programs within the user program with a minimum of programming overhead.

Reverse Vector R000

Because block 000, the starting block of the program, could never be used as a reverse vector, reverse vector R000 is used for a special purpose. Whenever the TRANS executes a block containing a reverse vector of R000, it considers all following blocks to be the return portion of the part program, even if they specify forward motions. Reverse vector R000 is useful primarily in manual mode, but also has an important effect in automatic mode.

In **Manual Mode** -- You should program a block containing a Reverse Vector Jump to R000 to indicate the end of the Forward program (profile). In Manual Mode, pressing and holding the FORWARD button at the Operator Station causes the TRANS to execute the Forward program. When the TRANS completes execution of a block containing a reverse vector of R000, the Forward input will be ignored and only the Return (Reverse) input can be used. While the Forward profile is being executed, FORWARD OPERATING will appear in the display. When reverse vector R000 is reached, the display will become REVERSE-NO COMMAND, indicating that only the Return input will be accepted.

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Note that, if reverse vector R000 is not programmed at the end of the Forward program, continuing to hold the FORWARD button depressed while in Manual Mode will cause the TRANS to execute the entire program, both the Forward and Reverse profiles.

In **Automatic Mode** -- When a Reverse Vector Jump to R000 is encountered in automatic mode, it is essentially transparent, for both the forward and reverse profiles will be executed normally. However, receipt of the homing input after reverse vector R000 has been encountered will not cause a jump to be made, because the TRANS is already executing a return program.

It is good practice to program a homing command in the part program after reverse vector R000; however, it is not required. The TRANS operates correctly without the homing command in all cases except where power has dropped after execution of reverse vector R000 and before execution of the Jump to Block 000 and Stop.

In that case, when power is re-applied the TRANS has stored the fact that a reverse program was in progress and it continues where it left off when the Home command is received (Automatic Mode) or the RETURN pushbutton is pressed (manual Mode). When the reverse program is complete, the TRANS checks if a homing command was performed. If not, it displays HOMING MISSING (Manual) or READY MISSING (Automatic). Issuing the Home command again or pressing RETURN a second time transfers control to block 120 and the slide is then properly homed.

Note that some users omit the homing command in the reverse program because they don't want to take the time for the system to execute the complete homing process in each cycle. Instead, they program an absolute move to zero.

Unlike many other controls, this is not a problem in the TRANS, because it executes the complete homing process only when first powered up. Subsequent homing commands are essentially an absolute move to zero, with the TRANS remembering where home is and checking that it is reached when commanded.

5.3.16 Block Repeat (NC Code E)

If an unconditional jump (JN) or a jump to subroutine (JU) has been programmed in a block, a block repeat value (XX) can also be entered. This causes the complete block, including the G-code and jump to be repeated up to 99 times.

5.4 PROGRAM DATA

Because the control adapts to any incremental encoder resolutions, position programming is always uniform.

Travel units are: 0.0001 inches or 0.001 mm
Maximum travel range: +/-838.8600 inches or +/-8388.600 mm

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5.5 PROGRAMMING

This section first describes the procedure for displaying a program block without changing it. This can be done from the keyboard without using the Program keyswitch. The following paragraphs then describe procedures for entering a program. This requires that the Program keyswitch be used to enable Program Entry/Edit Mode.

Note that values must be entered for all parameters before an application program can be entered.

5.5.1 Display Program Blocks

Use the following procedure to step through and display the blocks of a program:

1. Generally you will want to select Manual Mode (selected from the Operator Station). Block display can occur while the unit is operating, but you can only examine the various lines within a block while that block is being executed. When execution is complete, the next block comes up in the display.

2. Establish communication between the TAM and the selected TRANS as described in Section 3.4.

3. Press 

then press 

4. N? will appear in the first positions of the display. Select the block number to examine by one of the following:

   a. Advance the block number successively pressing N and LF (Line Feed) to increment the block number to the one you wish to examine, or

   b. Type the number of the first block you wish to examine (leading zeros need not be entered), then press ENTER. If you make an error while entering the block number, press DEL (Delete) once for each digit to be deleted and re-key the digits, then press ENTER.

5. A summary of the contents of the block plus the first line of the block are displayed, as described below in Section 5.5.2. When ready, press LF (Line Feed) to examine the second line of the block. Data will appear in the format described for line displays below.

6. Each program block can contain 8 lines of information (10 lines for feed adaption option). Each time you press LF, you will step to the next line of the current block.

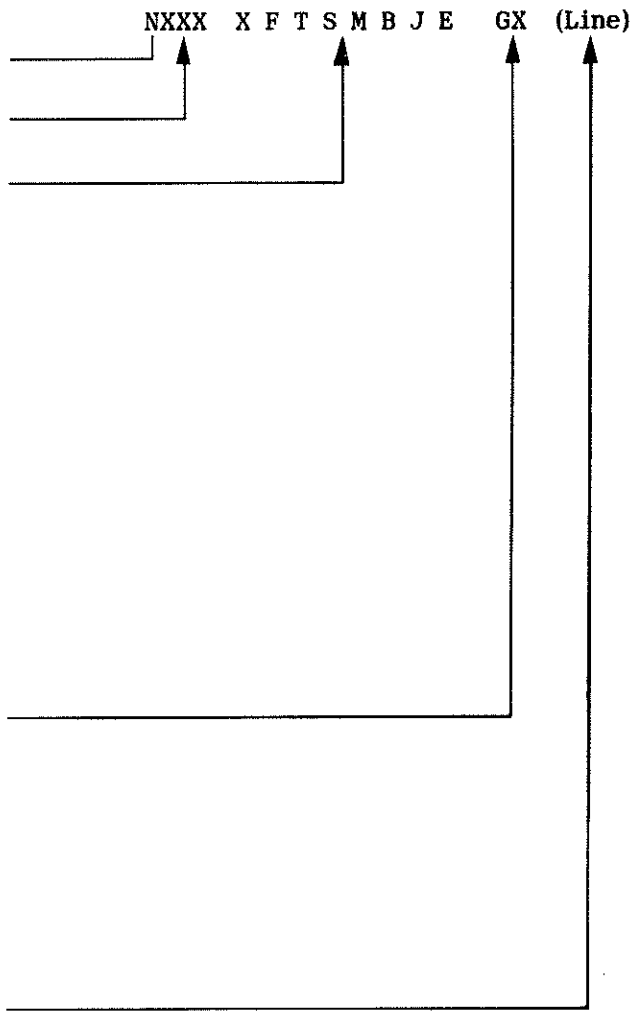
7. When you wish to examine the next block, press N and LF to advance to the next sequential block number, then use LF to step through and examine each line.

8. Block Display Mode is exited by selecting any other mode or by resetting the control.

5.5.2 Block Display Mode

The Alphanumeric display indicates the functions used in the current block. The display is shown as follows.

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N indicates block.

XXX indicates current block no.

Summary of contents of block - Presence of a letter indicates the type of information programmed in this block. A "-" appears at a letter position if that function is not programmed in this block.

X = Position
F = Feedrate or Dwell Time
T = Tool Correction Register Number
S = Analog Spindle Output (RPM)
M = Auxiliary Function Outputs
B = BCD Output Value
J = Jump
E = Block Repeat
*A = Feed Adaption Programmed
*0 = Idle Detection Programmed

NC G-code, as:
G0 = Homing
G1 = Position
G4 = Dwell
G5 = Feed to Positive Stop/Optional Function
G6 = Feed Ramp (optional TR32 software only)

Line Displays - This area is used to display the data programmed in each of the individual lines in the display. The LF (Line Feed) key is pressed to sequentially step through and inspect each line, from X - 0.

The line displays will be (decimal points appear as appropriate):

Line 1 = X -------	Position in inches or mm (7 digits).
Line 2 = F -----	Feedrate (inches or mm per min - 5 digits) or Dwell Time (in seconds - 4 digits).
Line 3 = T --	Two digit number of currently selected tool correction register.
Line 4 = S ----	Selected spindle speed in rpm (4 digits)
Line 5 = M ---------	Status of 8 auxiliary output functions. ⊛ = on (⊛ is a zero filled with lines) ⊛0 = off
Line 6 = B --	Two digit BCD output value.

* Will appear in the display only when the Feed Adaption option is installed.

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Line 7 = J? xxx — Jump, as follows:

JN xxx	- Unconditional jump to block xxx
JS xxx	- Jump to block xxx & Stop
JC xxx 1234	- Conditional jump to block xxx based on the state of condition lines 1234
JU xxx	- Jump to subroutine at block xxx
JR xxx	- Reverse vector - jump to block xxx
J RETURN	- Return from subroutine

Line 8 = E -- — Specifies number of times execution of this block will be repeated before the next sequential block is executed.

Line 9 = A _____ — Feed adaption (only when Feed Adaption option is installed). See Section 9.5.

Line 10 = O _____ — Idle detection (only when Feed Adaption option is installed). See Section 9.5.

5.5.3 Programming Block Functions

Because the program must be protected from accidental or intentional alteration by unauthorized personnel, programming access is only possible by using the Program key to enable Program Entry/Edit Mode.

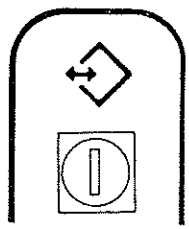
The TRANS monitors the parameters and the applications program to assure that all program functions are performed within the constraints established by the system parameters. If a function is programmed or attempted which would exceed the bounds established by these parameters, the control will halt and a diagnostic error message will be displayed.

Enter a TRANS Program as follows:

1. At the Operator Station, Switch the system to Manual.

2. Establish communication between your TAM and the selected TRANS as described in Section 3.4.

3. Insert the correct key into the Program keyswitch and turn it to select Program Entry/Edit Mode.



4. Press 

(Block No. Select)

5. Type the number of the first block you wish to program (leading zeros need not be entered), then press ENTER.

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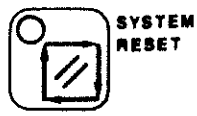
NOTE

At any time, if you make an error while entering data, press DEL (Delete) to delete the last data entered, then re-key the data and press ENTER.

You can use the N and LF (Line Feed) keys to successively increment the displayed block number.

6. Press DIALOG. 

NOTE

To guard against accidental program changes, DIALOG must be pressed to program each block. After pressing DIALOG, you can exit Programming Mode without changing the block by pressing the Reset key. 

7. FUNCTION? appears in the display. Now you must select one of the various functions, as described in the following sections.

   5.5.3.1 - Homing
   5.5.3.2 - Positioning -- includes absolute and incremental positioning, tool correction and analog spindle output.
   5.5.3.3 - Dwell
   5.5.3.4 - Feed To Positive Stop
   5.5.3.5 - Miscellaneous Functions -- Includes auxiliary outputs, BCD outputs, jumps and repeat.

NOTE

As you program a block, you can generally press LF (Line Feed) to skip lines you don't wish to program (BCD outputs for example). However, the COMMAND ERROR diagnostic message is displayed if you attempt to line feed past a required input. If this occurs, press CE to clear the error, then program the required function.

5.5.3.1 Homing

1. To select homing, press the Homing key, 

2. ZERO OFFSET? appears in the display.

3. If no zero offset is desired, enter 0. If an offset is required, key in the amount of the offset. See Section 5.3.5 for a discussion of homing and zero offset. If you make an error, press DEL (Delete) and re-key the data.

   If you attempt to press LF instead of entering 0 or some value, COMMAND ERROR appears in the display, as described in the note above.

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4. When your data is correct, press ENTER.

5. FEEDRATE? now appears in the display. If you want the machine to operate at the homing rate specified in parameter P15, press LF (Line Feed).

   Note that the system will operate at the parameter-specified homing speed during its first homing operation, regardless of any feedrate you may select.

   To select a feedrate for this homing operation, key in a feedrate value, then press ENTER.

8. AUX FUNCTION? now appears in the display. You will now step through and select any desired miscellaneous functions, such as auxiliary outputs, BCD outputs, block jump, or block repeat. Selection of these functions (or skipping them) occurs in every block which is programmed. See Section 5.5.3.5 for a description of programming procedures.

5.5.3.2 Positioning

1. To select positioning, press the Positioning key. 

2. ABSOLUTE? appears in the display. In absolute positioning, all movements of the slide are made to some absolute distance from the machine reference position. Thus, if the slide is at +5 inches, a command to travel to +6 results in a 1 inch feed in the positive direction.

   Press LF (Line Feed) to select absolute positioning. If absolute positioning is not desired, skip to step 5.

   Note that absolute positioning must be selected in the first positioning command of the program, since program operation could begin at the home or toolchange position.

3. WITHOUT LAG? now appears in the display. If positioning with lag finishing is required, press the lag finishing key. This specifies that the slide must be stopped in position before any miscellaneous functions (e.g., auxiliary functions and block jumps) remaining in this block are executed or before the next block is executed. 

   If positioning without lag finishing is OK, press LF (Line Feed). In this case, the position lag from one block will not be completed before the next block is executed. 

   See Section 5.3.7 for more information on positioning with/without lag finishing.

4. Because absolute positioning was selected, DESTINATION? appears in the display. Key in the required destination as +/-xxx.xxxx inches or +/-xxxx.xxx mm. Note that the TRANS assumes a positive move if no sign is entered. The minus sign can be keyed before or after the number is keyed. Also note the the negative sign is a toggle press to enter minus, press again to delete minus. Now skip to step 8.

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5. If absolute positioning is not desired, incremental positioning must be selected, by pressing 

6. WITHOUT LAG? now appears in the display. If positioning with lag finishing is required (slide stopped in position before the next function is executed), press the lag finishing key. 

   If positioning without lag finishing is OK, press LF (Line Feed). In this case, the position lag from one block will not be completed before the next block is executed. 

   See Section 5.3.7 for more information on positioning with/without lag finishing.

7. Because incremental positioning was selected, "DISTANCE?" now appears in the display. Key in the required positioning distance as +/- xxx.xxxx inches or xxxx.xxx mm. When this command is executed, the slide will travel the specified distance from its current position in the specified direction.

8. When entering either distance or destination, if you make an error, press DEL (Delete) and re-key the data. 

9. When your data is correct, press ENTER. 

10. FEEDRATE? now appears in the display. Key in a feedrate value, then press ENTER. If you attempt to select a feedrate greater than the parameter-specified maximum rapid traverse speed (P16), the RANGE ERROR diagnostic occurs.

    If you wish the feed to occur at rapid traverse rate, press the Rapid key. A fixed rapid rate, specified by program parameter P16, is then selected. 

11. TOOL CORRECTION? now appears in the display. Press LF (Line Feed) if there is no requirement for operator-accessible dimension offsets, or if the tool correction register number (and its associated value) chosen in a previous block is still to be used.

    To select a correction register, key in a number from 1 to 20 to specify the desired correction register, then press ENTER. The operator can then enter a value in that correction register which will be added to the dimension in this and all subsequent moves, until a different tool correction register is selected or the control is reset.

    If you had selected a tool correction register in a previous block, but do not wish to use it in this or subsequent blocks, enter a tool correction register number of 0, then press ENTER.

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12. SPINDLE RPM? now appears in the display if analog spindle output is enabled in parameter P40. Key in the speed in rpm at which the spindle is to operate in this and subsequent blocks, then press ENTER>

    If you press LF to skip this entry, the last spindle speed selected will be used in this block.

    The maximum spindle rpm range is +/-9999 rpm. However, your input range is limited (in both + and - directions) by the maximum rpm/10 volts specified in parameter P38. Ten volts is the maximum value of the analog command signal to the spindle controller. If the value of P38 is reduced after your program is entered, the instructions will be executed, but the spindle speed will be limited by the new value in P38, regardless of a higher speed entered in a program block.

13. AUX FUNCTION? now appears in the display. You can now step through and select any desired miscellaneous functions, such as auxiliary functions, BCD outputs, block jump or block repeat. Selection of these functions (or skipping them) occurs in every block which is programmed. See Section 5.5.3.5 for a description of programming procedures.

5.5.3.3 Dwell

1. To select a dwell time, press the Dwell key. 

2. DWELL TIME? now appears in the display. Key in the dwell time in seconds, from 0.01 to 99.99. You must enter the decimal point in the proper position, or the TRANS assumes whole seconds.

   If you make an entry error, press DEL (Delete) and re-key the data.

   If you attempt to enter too many digits, the diagnostic message FORMAT ERROR appears in the display, and the LED on the CE key lights. Correct by pressing CE to clear the error, then enter the correct data.

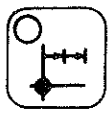
3. When your data is correct, press ENTER.

4. AUX FUNCTION? now appears in the display. You can now step through and select any desired miscellaneous functions, such as auxiliary functions, BCD outputs, block jump, or block repeat. Selection of these functions (or skipping them) occurs in every block which is programmed. See Section 5.5.3.5 for a description of programming procedures.

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5.5.3.4 Feed To Positive Stop

1. To select Feed To Positive Stop, press the  key.

2. ABSOLUTE? appears in the display. As in normal positioning (Section 5.5.3.2), press LF to select absolute positioning or  to select incremental positioning. If incremental positioning is chosen, skip to step 4.

3. When absolute positioning is selected, DESTINATION? appears in the display. Because the function is used to move against a stop, the final position is unknown. This value is used to limit the maximum travel of the slide in its search for the stop. Enter a destination value just greater than the position where the positive stop is expected. Press ENTER, then skip to step 5.

   If the slide reaches this destination without encountering a stop, movement halts, POS STOP MISSING is displayed and a soft fault occurs.

4. When incremental positioning is selected, DISTANCE? appears in the display. Because this function is used to position against a stop, the final position is unknown. This value is used to limit the maximum travel of the slide in its search for the stop. Calculate the maximum distance from the current position which the slide will need to travel to reach the stop. Key that value in, press ENTER and go to step 5.

   If the slide travels the specified distance without encountering a stop, movement halts, POS STOP MISSING is displayed and a soft error occurs.

5. FEEDRATE? now appears in the display. Key in the desired feedrate value, then press ENTER. Parameter P25 specifies "Max Feedrate For G5". If a feedrate value greater than this is keyed in, a soft fault will result and "RANGE ERROR" will be displayed.

6. TOOL CORRECTION? now appears in the display. Press LF (Line Feed) if there is no requirement for operator-accessible dimensions offsets, or if the tool correction register number (and its associated value) chosen in a previous block is still to be used.

   To select a correction register, key in a number from 1 to 20 then press ENTER. The operator can then enter a value in that correction register which will be added to the dimension in this and all subsequent moves, until a different tool correction register number is selected or the control is reset.

   If you had selected a tool correction register in a previous block, but do not wish to use it in this or subsequent blocks, enter a tool correction number of 0, then press ENTER.

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7. SPINDLE RPM? now appears in the display if analog spindle output is enabled in parameter P40. Key in the speed in rpm at which the spindle is to operate in this and subsequent blocks, then press ENTER.

   If you press LF to skip this entry, the last spindle speed selected will be used in this block.

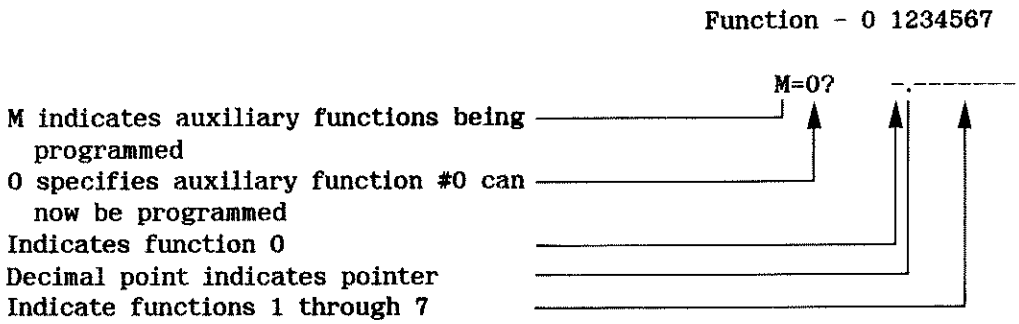
8. AUX FUNCTION? now appears in the display. You can now step through and select any desired miscellaneous functions, such as auxiliary functions, BCD outputs, block jump, or block repeat. Selection of these functions (or skipping them) occurs in every block which is programmed. See Section 5.5.3.5 below for a description of programming procedures.

5.5.3.5 Miscellaneous Functions

1. To select miscellaneous functions directly, press  This portion of dialog programming also occurs as a part of all the other programming functions.

2. AUX FUNCTION? now appears in the display. If you want to select auxiliary functions, press ENTER. If not, press LF (Line Feed) to skip to the BCD output selection (step #6).

3. When auxiliary functions have been selected, the display will be:



4. One of three different conditions may be selected for each auxiliary function: on, off or maintain current status.

   * Press 1 to turn the function on; (zero filled in with lines) appears in the display to indicate the function to be turned on.
   * Press 0 to turn the function off; 0 appears in the display to indicate the function to be turned off.
   * Press DEL to maintain current output status; a dash appears in the display to indicate this.

5. The display then advances to M=1? Continue programming the functions as described above. If the displayed status of an auxiliary function is acceptable, press LF (Line Feed) to increment the pointer to the next function. After auxiliary function 7 is programmed, the pointer will wrap around to M = 0? Any mistakes made in the programming can be corrected by again following the above procedure.

   At any time you can press ENTER to exit auxiliary function input mode, and the TRANS will accept the function as displayed.

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BCD Outputs

6. Once auxiliary functions are selected (or skipped) BCD OUTPUT? appears in the display. If you want to select a BCD output code, key in a two digit code (00-99), and press ENTER. If a BCD output is not desired, press LF (Line Feed) to skip to the Block Jump selection (step #7).

   The specified value will be represented in binary-coded decimal format on the BCD output lines when this block is executed.

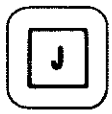
Block Jump

7. When BLOCK JUMP? appears in the display, you can select one of five types of jumps as described below, or press LF (line Feed) to skip Block Jump entry and advance to Block Store (step #10).

NOTE

A jump must be made only to a block with programmed functions.

a. Immediate (Unconditional) Jump.

   1. Press J. 

   2. J=N? appears in the display. Key in the target block number, then press ENTER. Skip to step #8 (Block Repeat).

b. Jump to Subroutine.

   1. Press SUB. 

   2. J=U? appears in the display. Key in the block number of the first block of the subroutine. Then press ENTER. Skip to step #8 (Block Repeat).

      Note that all subroutines must be terminated with a J RETURN.

c. Return

   1. Press RET. 

   2. Skip to step #10 (Block Store).

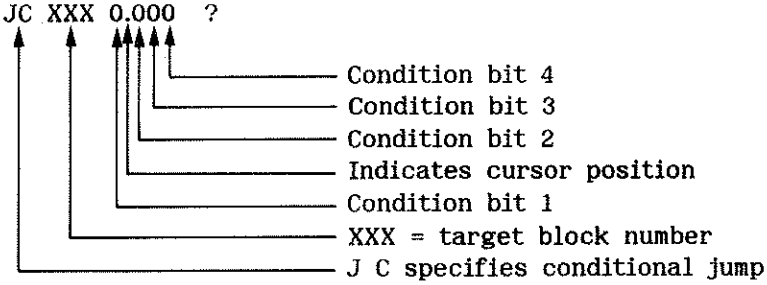
d. Conditional Jump

   1. Press COND. 

   2. J=C? appears in the display. Key in the target block number. Then press ENTER.

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3. The display is now JC XXX 0.000 ?



4. Press 1 to specify bit on; (zero filled with lines) appears in the display to indicate the on condition selected. The cursor moves to bit 2.

   Press 0 to specify bit 1 off; 0 appears in the display to indicate the off condition selected. The cursor moves to bit 2.

   Press Line Feed to move the cursor to the next bit position without changing the displayed value.

   After condition bit 4 has been programmed, the cursor will wrap around to point to bit 1 again.

5. Proceed as indicated in step 4 until the selected condition has been keyed in, then press ENTER. Any mistakes can be corrected by repeating the procedure after bit 4 is programmed and the cursor has returned to bit 1.

6. Skip to step #10 (Block Store).

e. Jump and Stop

1. To select Jump and Stop, press 

2. J=S? appears in the display. Key in the target block number, then press ENTER. Skip to step #10 (Block Store).

f. Reverse Vector

1. To select Reverse Vector programming, press 

2. J-R? appears in the display. Key in the new target block to which the TRANS will jump is a Return command is issued, then press ENTER. If this is the end of the Forward profile (full depth), enter 000 for the reverse vector. Skip to step #10 (Block Store).

Block Repeat

8. If an Immediate (unconditional) Jump or a Jump To Subroutine has been programmed, BLOCK REPEAT? appears in the display.

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9. If repetition of the current block is not required, press LF (Line Feed). If the block is to be repeated, key in the number of repetitions (from 1 to 99), then press ENTER.

Block Store

10. At this point, all lines of the block have been programmed, but it has not yet been stored in memory. The LED on the Store key (see drawing in step 11) will be lighted indicating that the block can bow be stored in memory.

    If you choose, you can successively press LF (Line Feed) to step through and review each line of the block.

    If you wish to edit a line, press the Edit key  , then key in the correct data and press ENTER.

11. To store the completed block in memory, press the Store key. The display is then incremented to the next sequential block number.

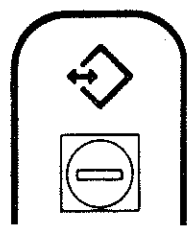


NOTE

The Store key cannot be pressed until you have gone through the entire programming procedure, even if you need none of the miscellaneous functions.

12. Now you can return to the beginning of the program procedure (Section 5.5.3) and program the next block. You must press DIALOG to again begin the program procedure. If you wish to program some block other than the one displayed, press N, key in the block number, press ENTER, then press DIALOG.

13. Continue the programming procedure described in the above paragraphs until the desired number of blocks have been programmed. Then turn the Program keyswitch back to its locked position and remove the key.



14. Press the Reset key to reset the control, then perform a homing routine. Assuming all elements of the system are indicating correct status, you can now use the FORWARD and RETURN pushbuttons at the Operator Station to check the forward and reverse portions of your program.



15. If program errors are discovered, edit your program as described in Section 5.5.4, Program Editing Procedures.

16. When the program is properly checked out, home the axis, then select Automatic Mode at the Operator Station. Assuming all elements of the system are reporting correct status, NO START will appear in the TAM display. The applications program is now ready to be run under control of the Line Control device.

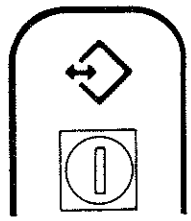
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5.5.4 Program Editing Procedures

1. At the Operator Station, switch the system to MANUAL.

2. Establish communication between your TAM and the selected TRANS as described in Section 3.4.

3. Insert the correct key into the Program keyswitch and turn it to the Program Entry/Edit Mode.



4. Press  then press 

5. Type the number of the block you wish to edit (leading zeros need not be entered), then press ENTER.

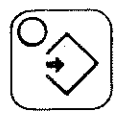
6. Successively press LF (Line Feed) to advance the display to the line where a change is necessary.

7. To change the displayed line, press the Edit key, key in the revised value, then press ENTER. Note that leading and trailing zeros need not be typed. If the Program keyswitch is not in Program Entry/Edit Mode when Edit is pressed, WRITE PROTECTED will appear in the display.



   If you make a typing error, or want to back up in the sequence for some reason, press DEL to delete the last entry. Note that DEL can be used to delete a sequence of keystrokes. For example, if you've selected Edit mode, line X and typed in 10, pressing DEL once deletes the 0; pressing DEL a second time deletes the 1; pressing it a third time deletes your selection of Edit mode.

8. When satisfied with the revised block, press the Store key to enter it into memory. If another block must be edited, repeat this procedure from step 4.



9. When all incorrect blocks have been corrected, turn the keyswitch back to its locked position and remove the key.

10. Press the Reset key to reset the control, then perform a homing operation. Assuming all elements of the system are indicating correct status, you can now use the FORWARD and RETURN pushbuttons at the Operator Station to check the forward and reverse portions of your revised program.



11. If additional program errors are discovered, repeat the edit procedure.

12. When the program is properly checked out, home the axis, then select Automatic Mode at the Operator Station. Assuming all elements of the system are reporting correct status, NO START will appear in the TAM display. The applications program is now ready to be run under control of the Line Control device.

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13. Note that once all changes are made, the Delete key can be used to back out of Edit mode as described in #5 above, without the need to press Reset. This has the advantage that the axis does not have to be re-homed.

5.6 PROGRAMMING FLOWCHARTS

The following pages present TRANS-01 M programming information in handy flowchart form.

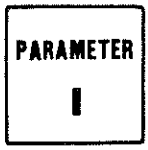
Following the flowcharts, you will find two examples, each complete with sample programming worksheets, a drawing of the program profile, and a list of keystrokes required to enter the program into the TRANS.

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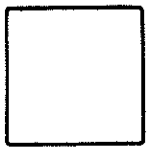
The following symbols are used in the TRANS flowcharts:



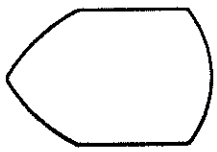
Programming Keyswitch in the programming position.



Parameter Keyswitch in the parameter entry position.



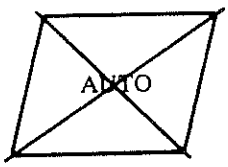
Key on the TAM keyboard to be pressed. Circle in upper left corner of box indicates key with LED. If circle is filled in, LED is lighted.



TAM display.



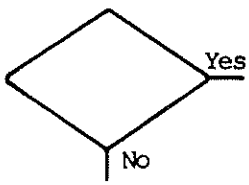
Enter data from TAM numeric keypad.



Procedure functional only when automatic mode is not selected on the Operator Interface.

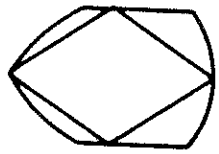


Follow procedure outlined by text in the symbol. This indicates that a procedure described in another flowchart must be followed.

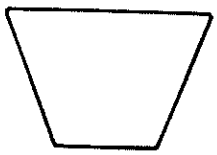


Branch. If the statement written within the symbol is true, the "yes" branch is taken. Otherwise, the "no" branch is taken.

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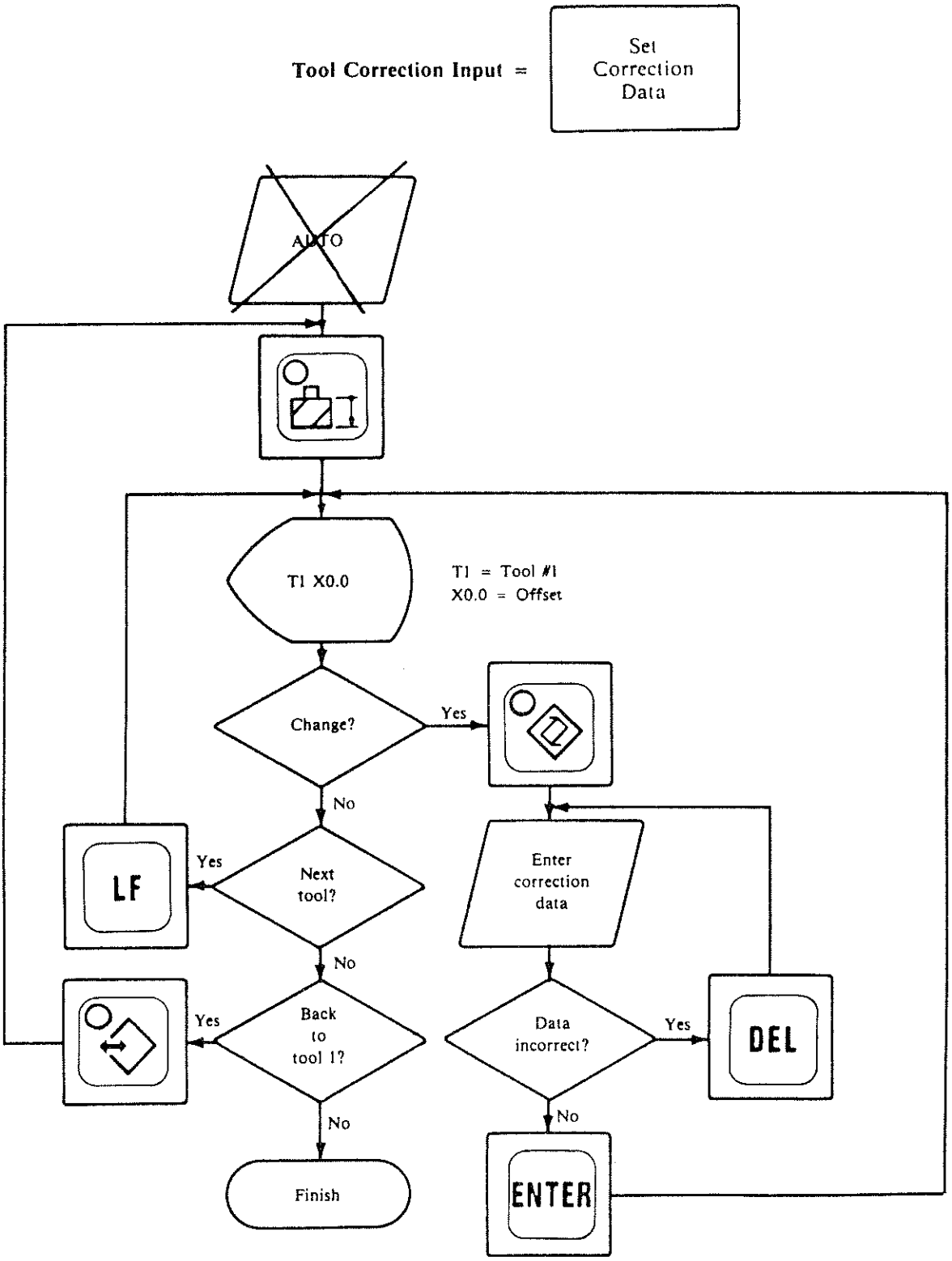


A question is shown in the TAM display to allow the user to select a branch in the programming procedure.



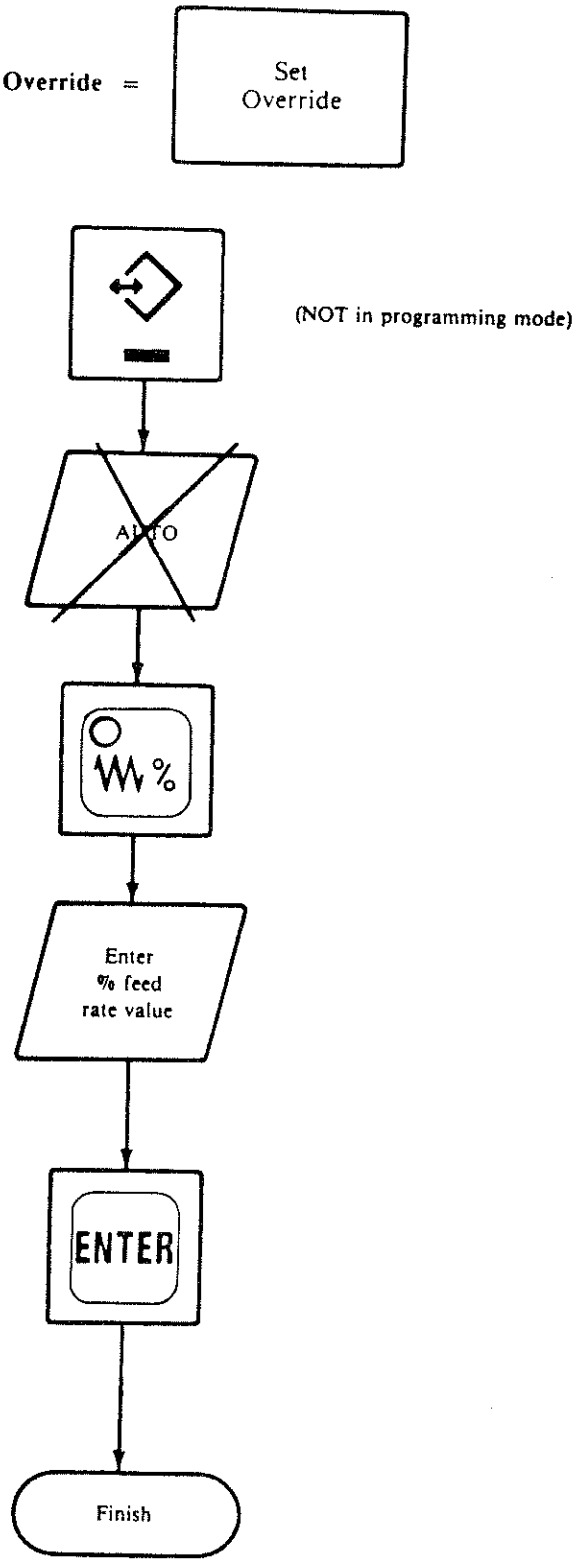
Indicates manual procedures performed on mechanical or electrical assemblies.

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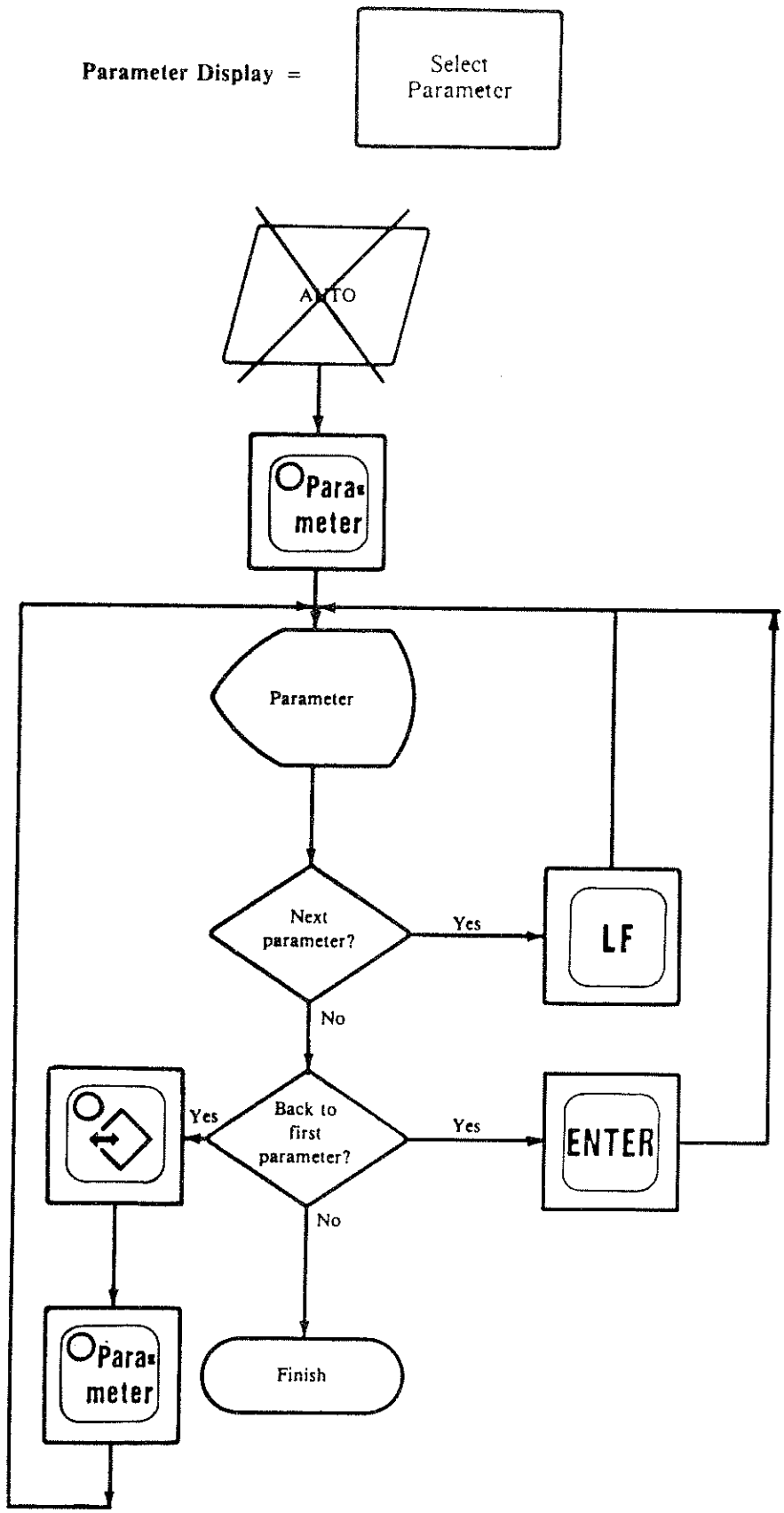
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Feedrate Override =

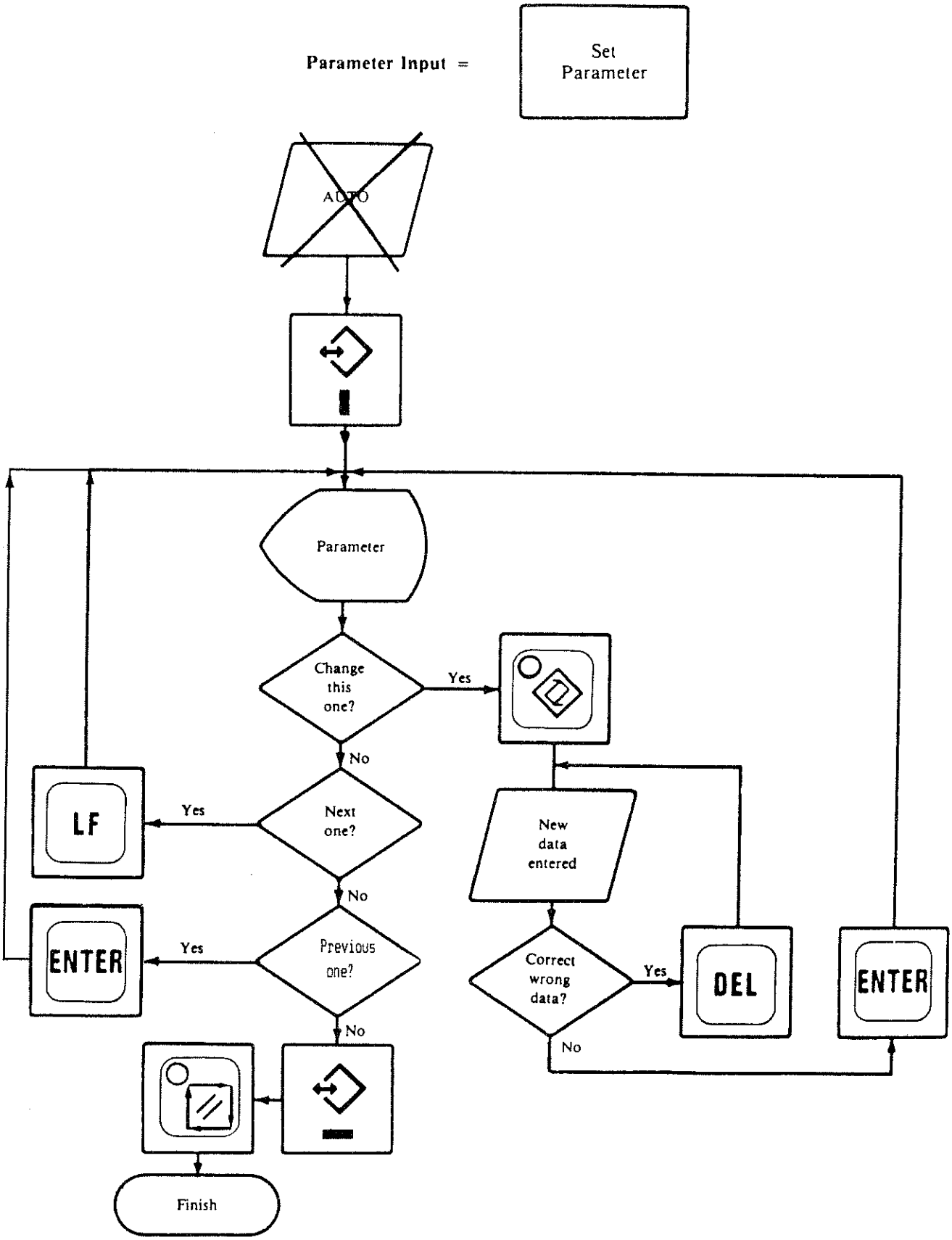


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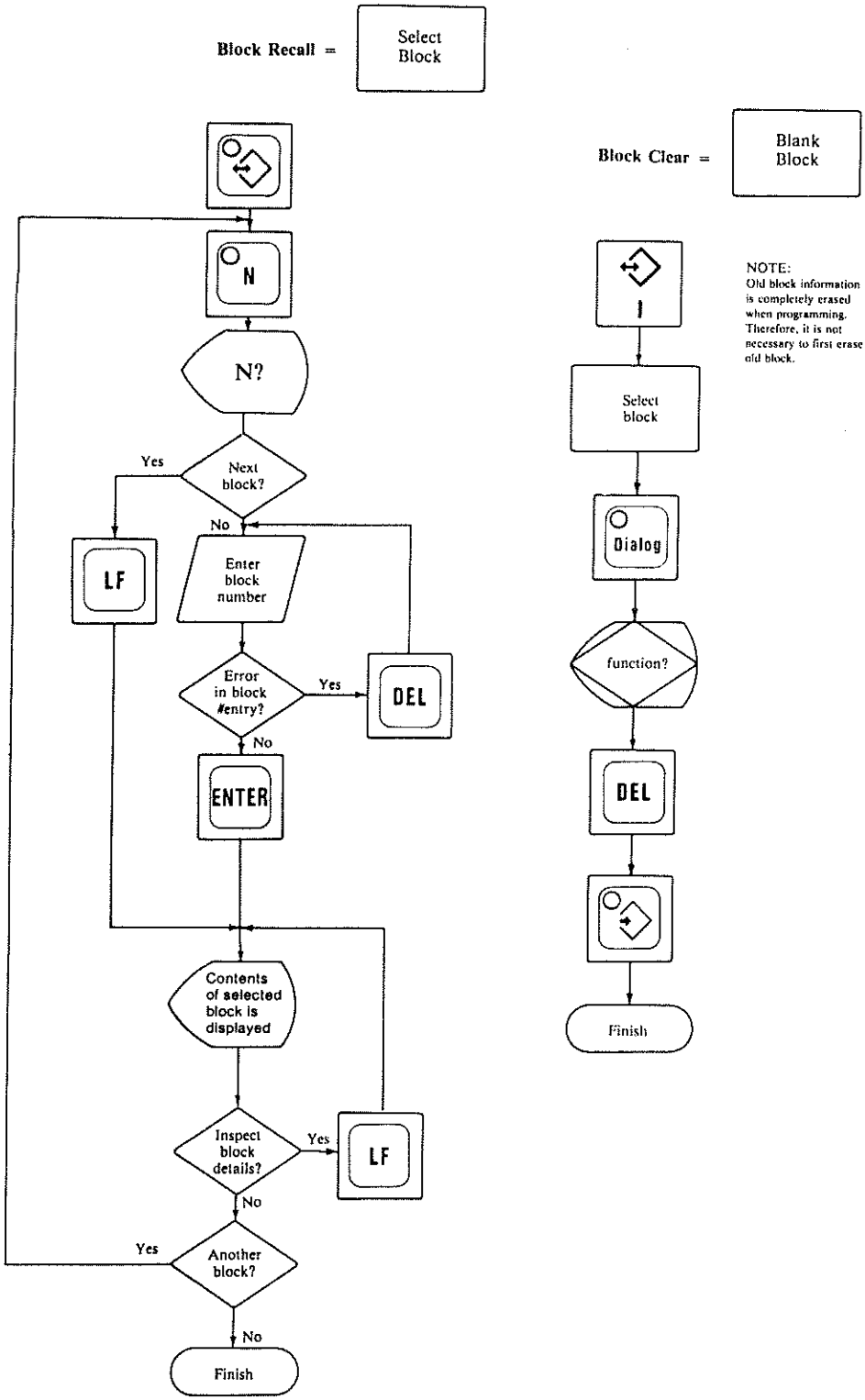
Parameter Display =



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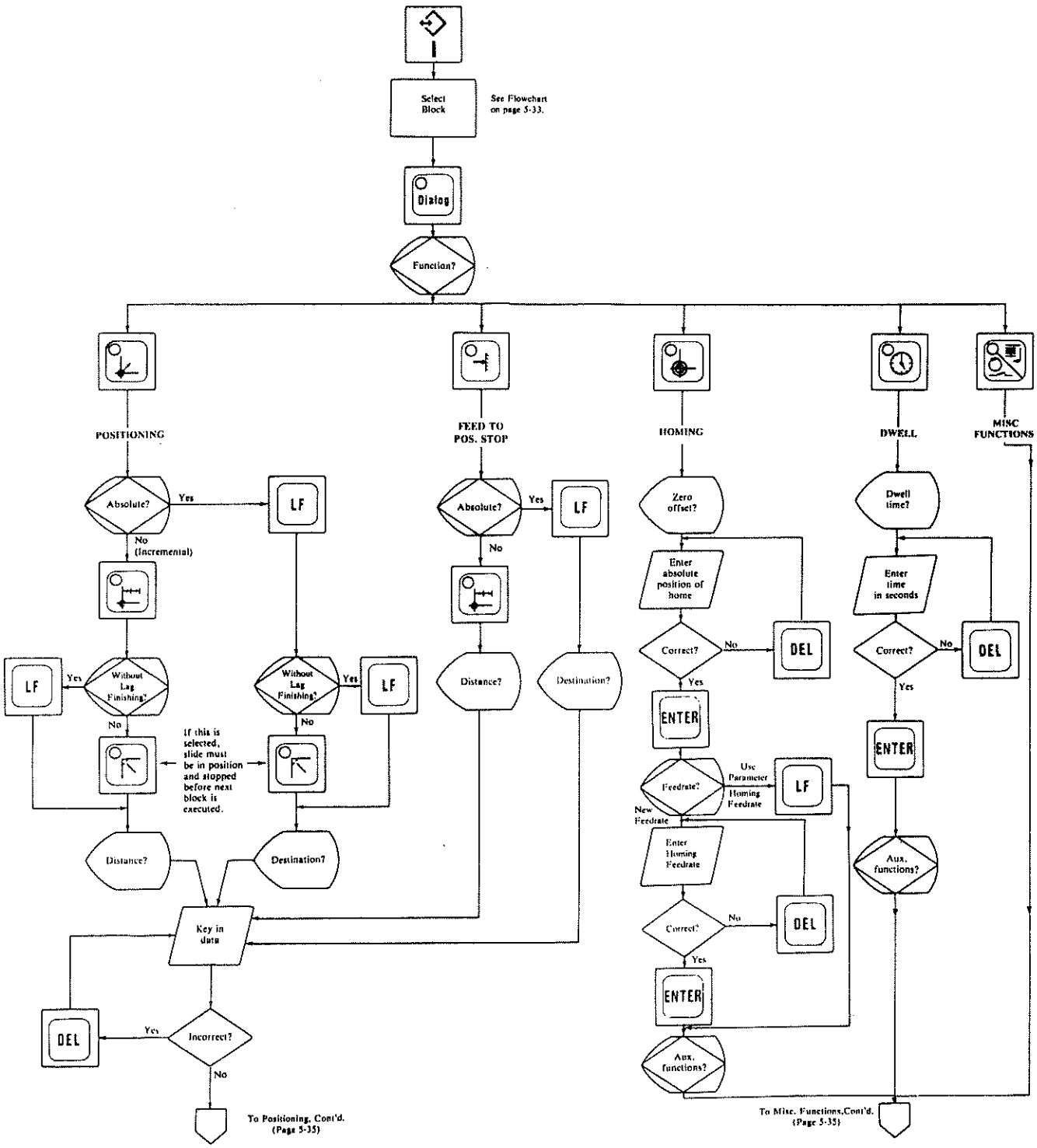


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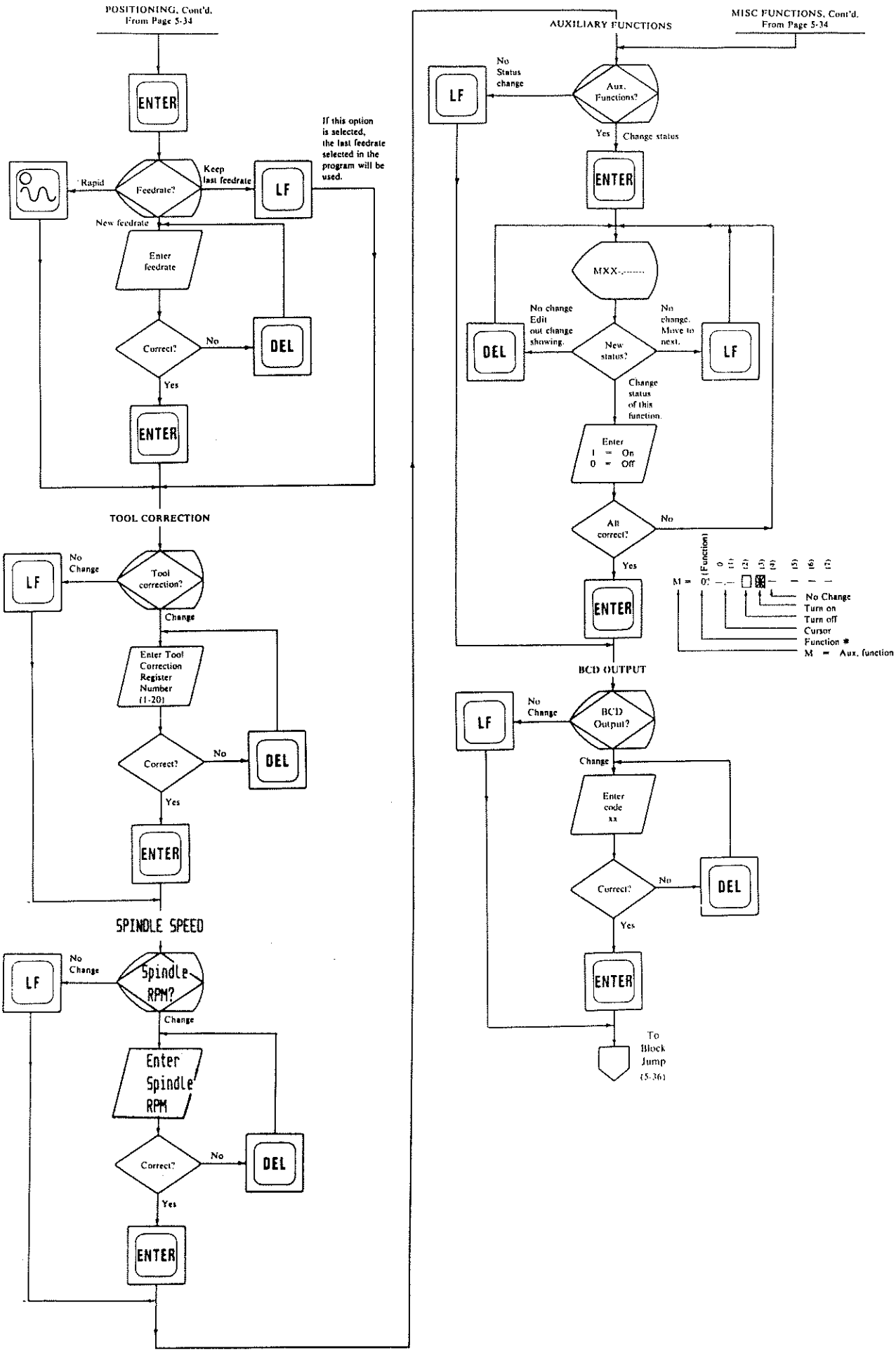


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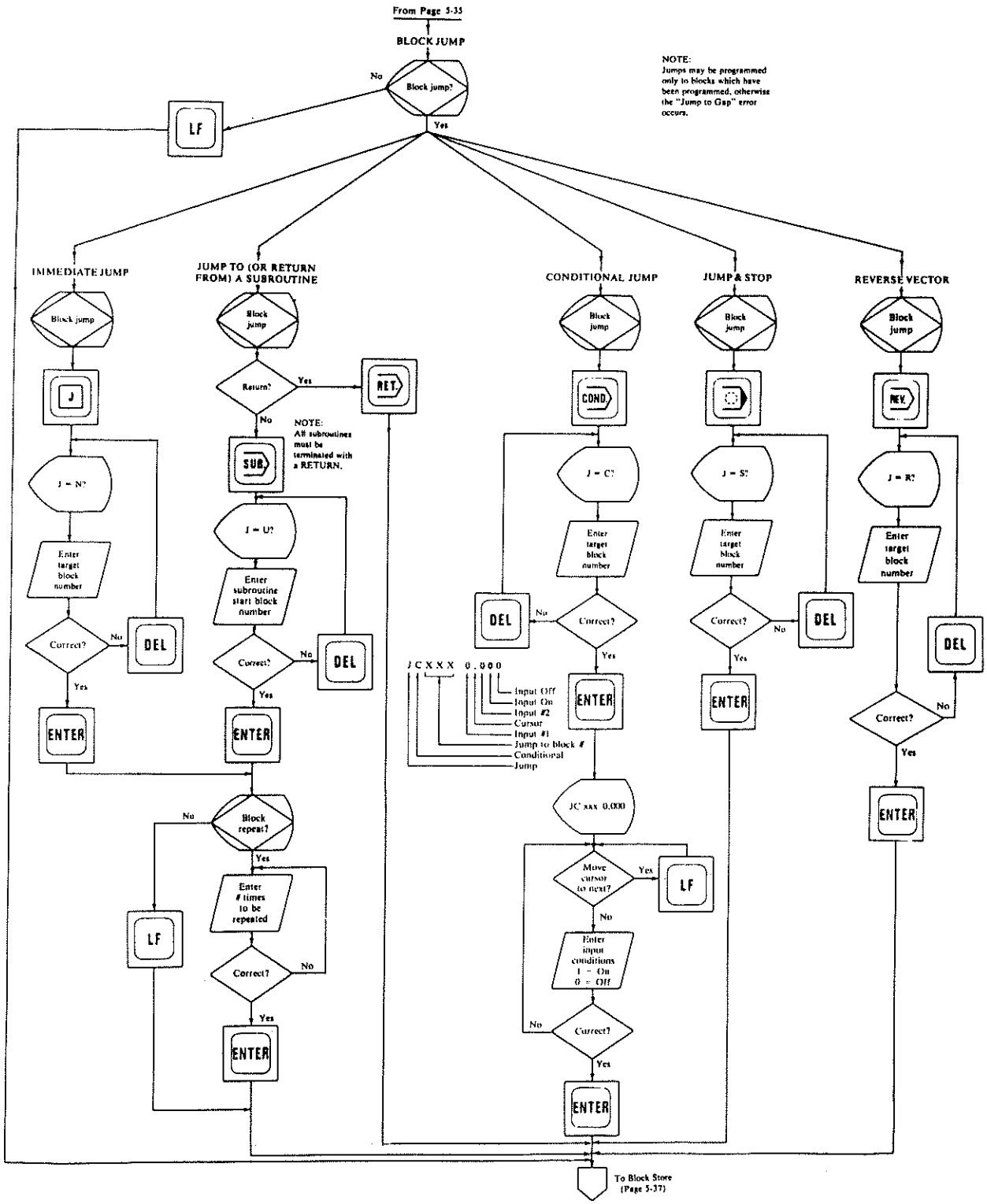
PROGRAM BLOCK FUNCTION



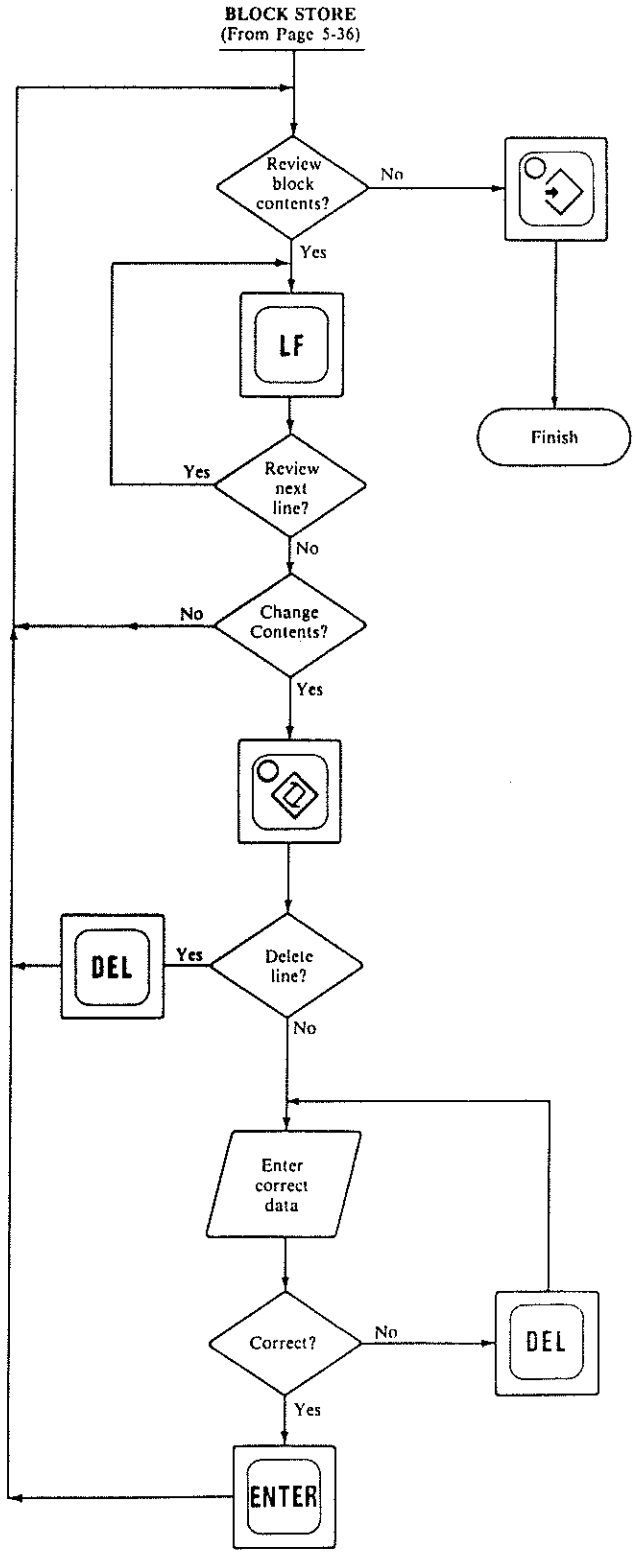
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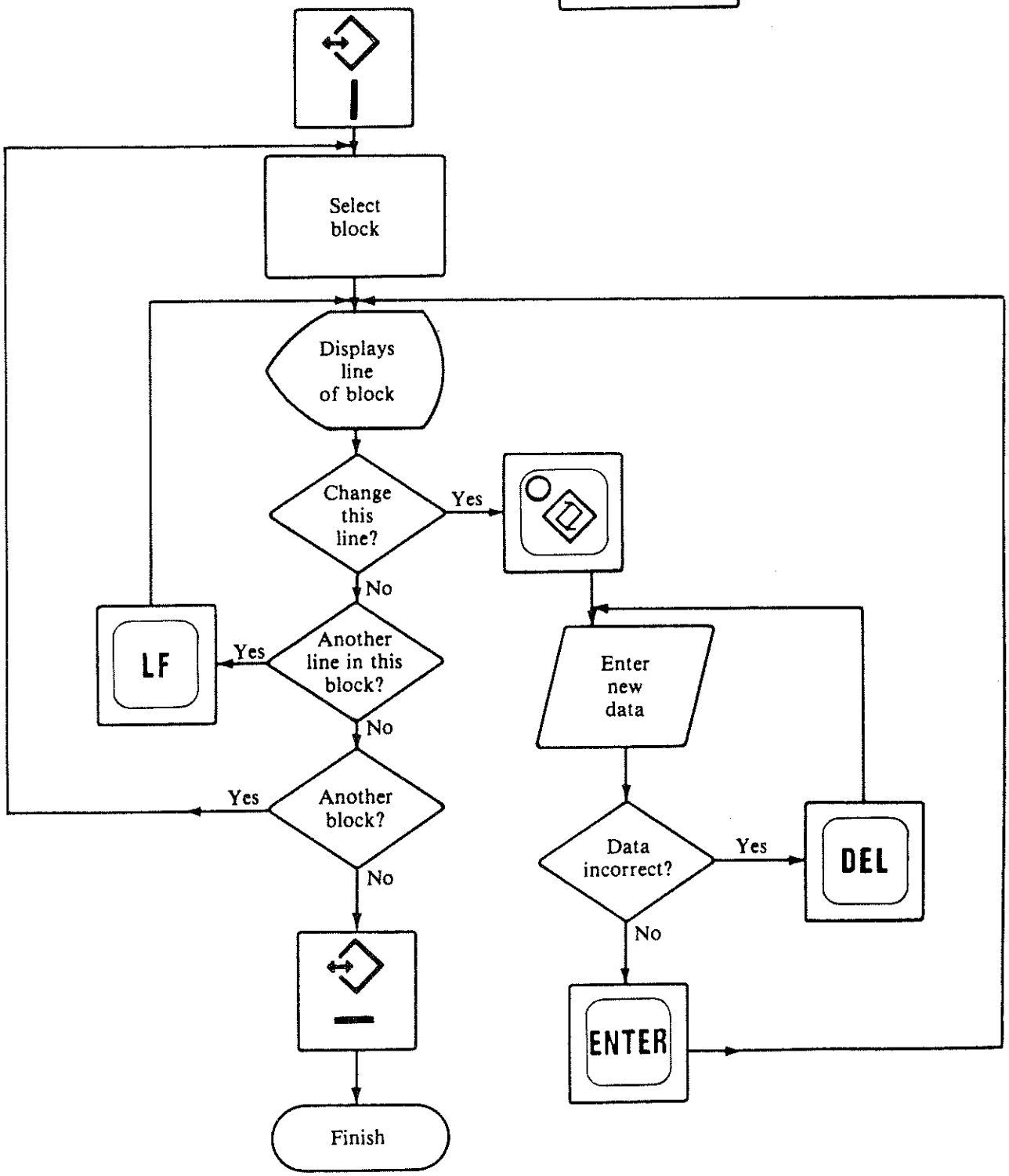


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Edit Programmed Data = Edit Program



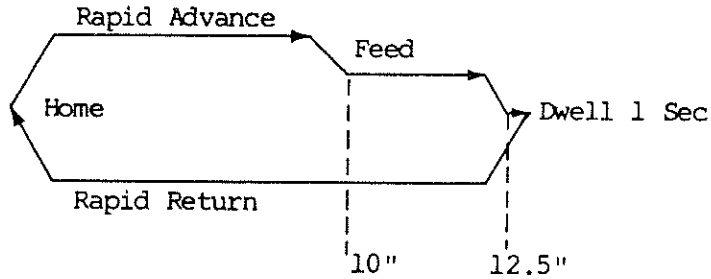
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5.7 PROGRAMMING EXAMPLES

To assist you in programming the TRANS, this section includes two sample slide profiles, the associated programs, and a presentation of the actual keystrokes required to enter each program into the TRANS.

5.7.1 Example Program 1

The first program is a simple slide profile, consisting of a rapid advance, a feed, a dwell and rapid return. A profile of this program is drawn below.



Each portion of the profile will be a block in the machining program, so four blocks will be needed:

Block 000 --- rapid advance
Block 001 --- feed
Block 002 --- dwell
Block 003 --- rapid return

As we write the program, consider the following:

1. Absolute dimensioning will be used and home will be called zero on the absolute grid.

2. Block 000 is programmed with a rapid advance to a point 10" from home. "Without Lag Finishing" will be selected, so that the feedrate changes smoothly from rapid advance to feed without stopping the axis. Note, however, that all other positioning blocks will be programmed with lag finishing to ensure that the slide is completely stopped and in position before executing the next block.

3. Block 001 will be programmed as a feed to 12.5" from home. A feedrate of 10 inches per minute is specified.

4. Block 002 selects a 1 second dwell to ensure proper completion of the operation. A reverse vector of 000 will also be entered in block 002 to disable the manual FORWARD pushbutton after the dwell time has elapsed. This indicates the end of the Forward profile.

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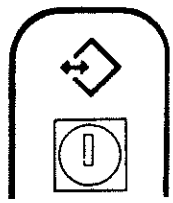
5. Block 003 selects a rapid return to home. A Jump To Block 000 And Stop will also be programmed in this block to position the program back at block 000 after the rapid return is executed.

6. Block 110 is used by the TRANS as the starting block for the tool change program. We specify the point 5 inches behind home as the "tool change position", so block 110 is programmed with an absolute move to -5 inches, plus a Jump To Block 000 And Stop.

7. Block 120 must contain a homing program. It will be programmed with a homing function with the zero offset set to 0, a feedrate of 30.0 inches/min and a Jump To Block 000 And Stop.

8. No auxiliary functions, tool correction values, spindle outputs or BCD codes will be used.

To enter this program, select Manual Mode on the Operator Interface, press the Reset key, then insert the Program key into the Program keyswitch and turn it to the Program Entry/Edit Mode.



The display will now contain "N?" along with whatever command is currently in block 000. Now enter each block by pressing the appropriate keys. The correct key sequence for each block is shown below.

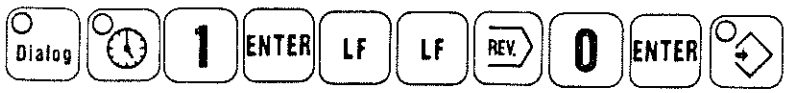
Block 000



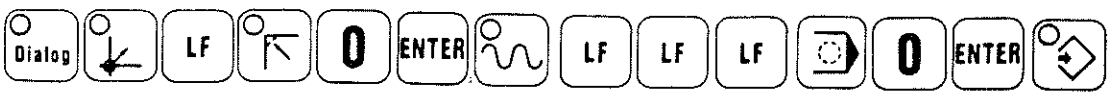
Block 001



Block 002



Block 003



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Block 110





Block 120





If COMMAND ERROR is displayed at any time during program entry, press CE to clear the soft error, then continue with the entry.

Now turn the Program keyswitch to its normal position and press the Reset key. Perform a homing function using the Return input on the Operator Interface, then step through the Forward program and monitor the program for errors. After the dwell time is completed, the display should be REVERSE-NO COMMAND, because of the execution of the R000 reverse vector. Press the RETURN button at the Operator Station to execute block 003.



Now try executing the program several times, but select a different display mode each time to see the various display modes in use.

The following page is a programming worksheet illustrating the program as it would be entered into the TRANS.

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5.7.2 Example Program 2

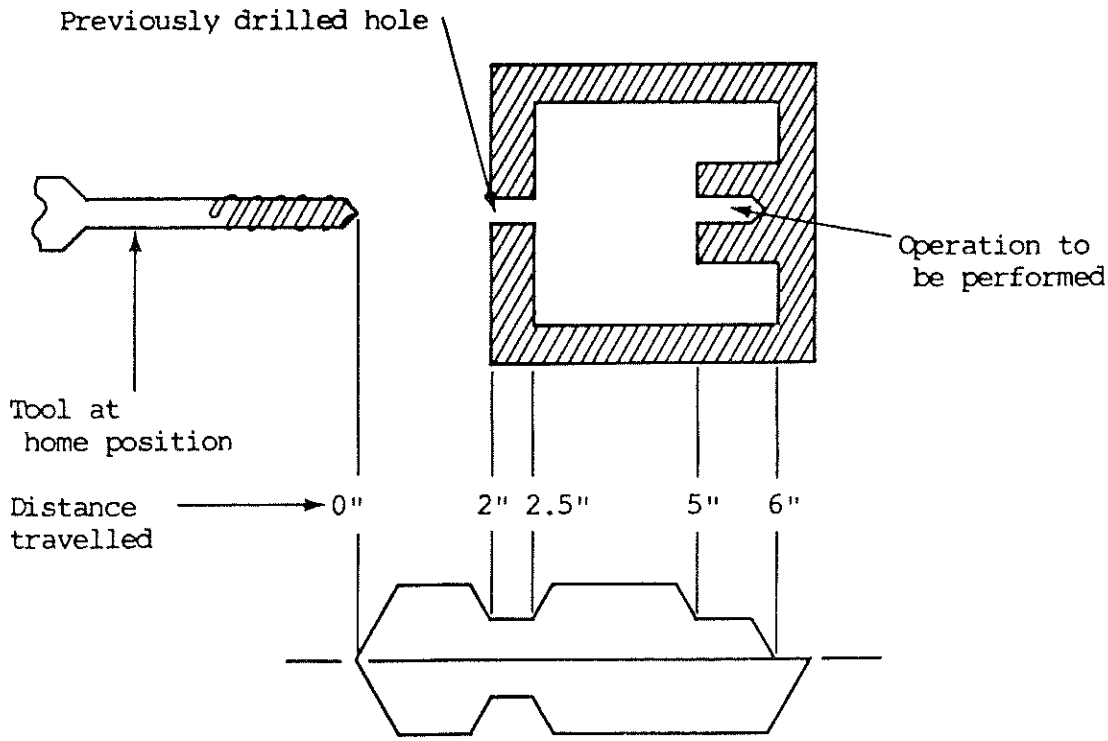
Our first program was a simple slide profile, illustrating how programming works. Example 2 illustrates a more complex program.

In this case, an operation is to be performed that requires a rapid traverse up to the workpiece, slowing of the axis to pass the tool through a previously drilled hole at a reduced feedrate, returning to rapid traverse velocity to move to the workface, machining the part, a dwell to allow cleaning of the borehole, and a return.

Auxiliary function 0 will control the spindle, and auxiliary function 1 will be the full depth indication.

If Emergency Return is activated, the tool must pass through the part surface at a reduced feedrate until it is clear of the part (reverse vectors must be used). The toolsetter will need control of the final depth, so tool correction value number 1 will be provided for his use.

The part cross section and the resultant profile appear as follows:



Profile

The next two pages are programming worksheets illustrating the program for example 2 as it would be entered into the TRANS.

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INDRAMAT TRANS 01 programming worksheet

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BLOCK NO.	FUNCTION: G0 HOMING	G1 POSITION	G4 DWELL	MISC.	G5 FEED TO POS STOP	ABSOLUTE	INCREMENTAL	W/O LAG FINISHING	WITH LAG FINISHING	[X] ZERO OFFSET, DISTANCE, OR DESTINATION	RAPID TRAVERSE	[F] FEEDRATE OR DWELL TIME	[T] NO CHANGE	TOOL CORRECTION	[M] AUXILIARY FUNCTION: LF	IF NO CHANGE	[S] NO CHANGE	BCD OUTPUT	[J] BLOCK JUMP: LF	IF NO CHANGE	TARGET BLOCK	CONDITIONS	[E] BLOCK REPEAT	COMMENTS
Tool Change 110		X				X			X	-5.0000	X		X				X					000		
Reverse Program 117		X				X		X		4.0000		50.0		00			X							
118		X				X		X		2.5000	X		X				X							
119		X				X		X		2.0000		50.0	X				X							
120	X									0.0000					00	- - - - - - -	X				X	000		

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The program assumes home to be zero on the absolute grid, that the spindle should be turned off after each cycle, and that the full depth indicator should be cleared when returned.

To enter the program, select Manual Mode on the Operator Interface, press the Reset key, and insert the Programming key into the Program keyswitch and turn it to the Program Entry/Edit Mode.

The display will now contain "N?" along with whatever command is currently in block 000. Now enter each block by pressing the appropriate keys. The correct key sequence for each block in program 2 is shown below.

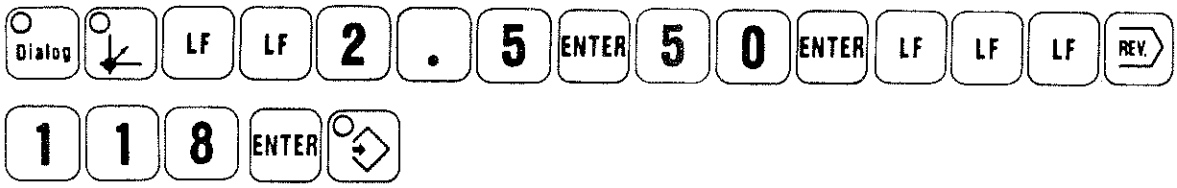
Block 000



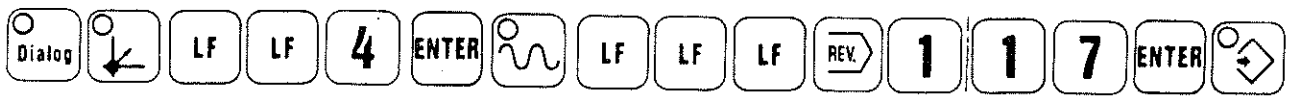
Block 001



Block 002



Block 003



Block 004



Block 005

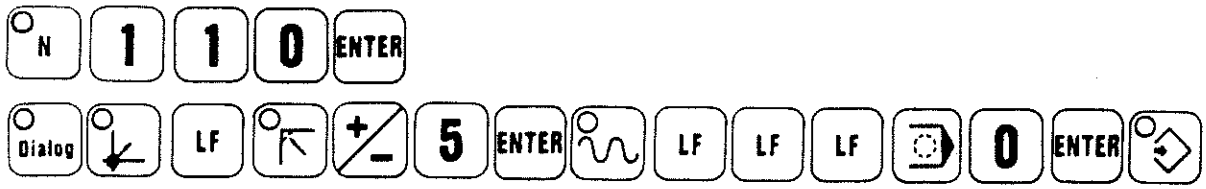


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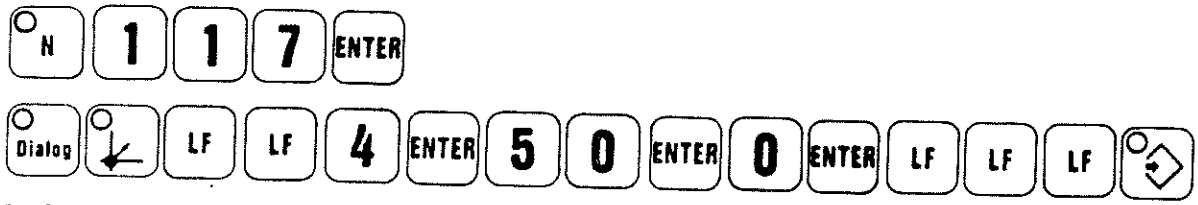
Block 006



Block 110



Block 117



Block 118



Block 119



Block 120



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CHAPTER 6. FUNCTIONAL DESCRIPTION

6.1 GENERAL

This chapter provides a functional description of the TRANS-01 M interfaces to the machine builder's equipment and describes the power interrupt handling features of the TRANS.

These interfaces are:

1. Interface to the Operator Station which contains the pushbuttons for manual controls.

2. Cycle Interface to the customer's Line Control, which is usually a programmable control which controls automatic operation of the system.

3. RS-422 Serial Interface for Indramat's Line Control Adaptor (LCA). The LCA communicates simultaneously with up to 30 TRANS controls, transmitting programs, parameters and tool corrections; receiving data such as slide position, diagnostics, etc. The LCA connects to a user supplied device, such as a programmable controller, terminal or computer.

   When the LCA is present, parameter P02 is used to specify whether the Enable Forward, Restart, Enable, Start and Homing signals are accepted from the serial bus or from the Cycle Interface. See Section 4.5 for details.

4. Other inputs and outputs are provided, including:
   * Four conditional jump input lines
   * Overtravel and limit switch inputs
   * Emergency stop circuit inputs/outputs
   * Auxiliary Function outputs
   * Acknowledgment inputs
   * Spindle control inputs and outputs

TRANS user interconnections are illustrated in the TRANS Interconnection Diagram included with your system documentation package.

The various signals on the TRANS interfaces are described below. Note that the wire numbers listed for each signal are applicable to standard INDRAMAT manufactured cables only.

Two signals are added to the interface with the Feed Adaption option. They are described in Section 9.5.3.

6.2 ENABLES

There are two enable signals which must be provided by the machine builder to enable operation of the TRANS. They are provided on the parallel Cycle Interface or by the Line Control Adaptor over the RS-422 serial channel (when the proper bits in parameter P02 are set to 1's).

The Enable signal must be present to allow any operation to occur. The Enable Forward signal is required to enable execution of the Forward cycle.

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6.2.1 Enable

Connector - TRANS X11
Pin - 3
Status - Normally open
Type - Input #19 to TRANS

This signal is required to enable operation of the TRANS. Loss of Enable interrupts both automatic and manual operation.

Enable is a master-release whose purpose is to ensure that motion of the unit can occur only when the machine is in the correct state, such as a workpiece in correct position, guards closed, etc.

6.2.2 Enable Forward

Connector - TRANS X11
Pin - 12
Status - Normally open
Type - Input #28 to TRANS

This signal is required to enable operation of the Forward cycle in both Manual and Automatic Modes. Loss of this signal stops execution of the Forward program. This signal is ignored in both the Tool Change and Return (homing) programs.

6.3 OPERATOR INTERFACE

Operator manual controls are available through a parallel operator interface. The machine builder will wire these signals to selector switches and pushbuttons at the transfer station. The normal programmed movements may be executed manually from this station, and they may be made only when the necessary enables are present.

The following signals are provided:

6.3.1 Automatic/$\overline{\text{Manual}}$

Connector - TRANS X11
Pin - 2
Type - Input #18 to TRANS

Generally wired to a selector switch. With Automatic selected, the TRANS will be in Automatic Mode and can be operated only by control signals provided by the Line Control. This is the normal mode of operation for the TRANS, where it performs a single program cycle each time the Line Control issues a Start signal.

Manual control at the unit Operator Station is possible only with the selector switch in MANUAL (line open) and when the TRANS diagnostic checking has not detected any interruptions. Should the TRANS refuse to operate, it will diagnose and display the reason. See Chapter 8 for a complete list of system diagnostics.

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If the TRANS is in Automatic Mode and is executing a part program, bringing this input low will cause an immediate stop condition and will force the TRANS into Manual Mode. The TRANS may be switched back into Automatic Mode and restarted by a Restart signal, provided that no manual operations have been performed. If manual operations (i.e., forward and reverse) are performed, a restart in Automatic Mode is not possible.

6.3.2 Forward

Connector - TRANS X11
Pin - 9
Status - Normally open
Type - Input #25 to TRANS

Generally wired to a pushbutton. The Automatic/Manual switch must be in MANUAL position and the Enable Forward signal must be present to enable this button. While this button is held depressed, the TRANS will perform the programmed operation (beginning at block 000), following the programmed forward profile. Releasing the pushbutton stops the movement. Pressing the button again continues the operation.

When the control completes execution of a block containing a reverse vector of JR000. which indicates the end of the forward profile (full depth), program execution halts and this input will be ignored. At this point, the Return input should be activated to perform the return (reverse) profile.

When first pressed, the FORWARD button will be effective only when the slide is in the Home position and the correct program and zero references are present. These beginning conditions can be achieved by pressing the RETURN button (Section 6.3.3) moving the slide to the Home position.

If, during forward cycle operations, the RETURN button is pressed, the unit must be Homed before the FORWARD button again becomes effective.

6.3.3 Return (Reverse)

Connector - TRANS X11
Pin - 10
Status - Normally open
Type - Input #26 to TRANS

Generally wired to a pushbutton which is usually labeled RETURN, REVERSE or RETURN TO HOME. The unit must be in the Manual Mode to enable this button. While this button is held depressed, the transfer unit will jump to block 120 or the current reverse vector and perform its reverse operation (as programmed in that block), returning to the Home position. See Section 5.3.3 for programming requirements for this operation.

Releasing the pushbutton stops the movement. Pressing the button again continues the operation.

If this pushbutton is pressed after the control has halted on a reverse vector, JR000 (end of forward profile, se above), the transfer unit will jump to block 120 or the current reverse vector and perform its reverse operation (as programmed in that block), returning to the Home position. See Section 5.5.3 for programming requirements for this operation.

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Releasing the pushbutton stops the movement. Pressing the button again continues the operation.

If this pushbutton is pressed after the control has halted on a reverse vector, JR000 (end of forward profile, see above), the control will continue executing the program beginning with the next sequential block. If the pushbutton is pressed before a reverse vector (JR000) is reached, program execution will begin with the block whose number is currently stored in the reverse vector. After reset, or if no reverse vector is programmed, execution begins with block 120.

Once the RETURN button has been pressed, the other operator controls are disabled until the slide has returned to the Home position.

If a fault exists, pressing the RETURN pushbutton clears the fault. Releasing the button, then pressing it again causes the TRANS to begin its reverse program. If the cause of the fault has not been remedied, the fault will reoccur when the button is pressed the second time.

6.3.4 Toolchange

Connector - TRANS X11
Pin - 13
Status - Normally open
Type - Input #29 to TRANS

Releasing the pushbutton stops the movement. Pressing and holding the button again continues the operation.

The TOOLCHANGE button is active only when the TRANS is at block zero and is not executing another program. If necessary, the RETURN pushbutton can be used to return the slide to Home before pressing TOOLCHANGE.

6.4 CYCLE INTERFACE

For operation of the transfer line through data bus control, the TRANS is equipped with a parallel Cycle Interface, containing the signals described below. The machine builder will wire these signals to the Line Control as required by the overall system design.

When Indramat's Line Control Adaptor is present, the proper bits in parameter P02 must be set to 0's to enable the TRANS to accept the Forward Enable, Restart, Enable, Start and Homing signals from the Cycle Interface.

Note that the TRANS is an intelligent subsystem and needs only a few signals to operate, greatly simplifying line control functions as compared to conventional systems. For example, the TRANS will recognize, and remember, the fact that an automatic cycle was interrupted by loss of main power.

The signals on the Cycle Interface are:

6.4.1 Enable and Enable Forward

These signals are described in Section 6.2.1 and 6.2.2 respectively.

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6.4.2 Start

Connector - TRANS X11
Pin - 11
Status - Normally open
Type - Input #27 to TRANS

This signal initiates the Automatic cycle, operating the TRANS in Single Cycle Mode, assuming that the following conditions are present:

1. Selector switch at the Operator Station is on Automatic.
2. Enable and Enable Forward signals have been present on the Cycle Interface for at least 50 msec.
3. All acknowledgments agree with their associated auxiliary functions.
4. The TRANS ensures that all start conditions are present and issues a Ready signal on the Cycle Interface.

Start is a high-level-sensitive signal, but its receipt is latched (stored) in the TRANS control, assuming the above conditions are present.

6.4.3 Homing

Connector - TRANS X11
Pin - 1
Status - Normally open
Type - Input #17 to TRANS

If in Automatic Mode, receipt of this signal causes the unit to immediately execute the program beginning at the current reverse vector or block 120 if no reverse vector is specified. If an automatic cycle is being executed, it is interrupted.

Homing also performs the Emergency Home function. The unit is homed per the user-entered reverse program and can perform various functions such as tool retraction during program execution.

If a reverse vector R000 has been executed in the current cycle, no jump will be performed, as the TRANS is considered to already be in a reverse program. See Section 5.3.3 for information on the basic homing program.

Conditions for acceptance of the Homing signal are:

1. Selector switch at the Operator Station is on Automatic.
2. Enable signal has been present on the Cycle Interface for at least 50 msec.

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6.4.4 Restart

Connector - TRANS X11
Pin - 4
Status - Normally open
Type - Input #20 to TRANS

This signal can be used to complete an automatic cycle after an "Immediate Stop" has occurred. For example, an immediate stop may occur if an auxiliary function acknowledgment is lost or if an emergency stop is executed. IMMEDIATE STOP is displayed. Once the condition is rectified, the automatic cycle can be completed by applying 24 volts to this input. Note that a normal Start signal (Section 6.4.2) will not be recognized after an immediate stop. Likewise, Restart will not be recognized if the automatic cycle is completed or has not begun.

This can be useful when machining criteria dictates that a surface cannot be machined twice if an emergency stop occurs. When a Restart is issued, only those units that did not complete their cycles will operate, all others will remain in the non-operating state.

If desired in a system, Restart and Start may be tied together to perform both functions with one input signal.

Restart is recognized only when the Enable and Forward Enable signals have been present on the interface for at least 50 msec. If a homing cycle is being restarted, Forward Enable is not required.

6.4.5 Ready

Connector - TRANS X10
Pin - 10
Status - Normally open
Type - Output #16 from TRANS

The TRANS issues the Ready signal to indicate that all conditions are correct for the automatic cycle. Ready will continue to be present on the Cycle Interface as long as all conditions for an automatic cycle remain acceptable. These conditions are:

1. Automatic Mode selected connector X11, pin 2 high).
2. Axis normalized (homing performed since power-up or clear).
3. Block 000 selected.

When the Ready line is high, a Start signal from the Line Control will be accepted by the TRANS, as long as the Enables are also present.

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6.4.6 Run

Connector - TRANS X10
Pin - 9
Status - Normally open
Type - Output #15 from TRANS

The Run signal is issued by the TRANS during the time that an Automatic signal is being executed. Because Run is provided to indicate completion of a cycle, it will remain high even during an immediate stop condition.

Run is issued during the Automatic cycle and when homing is performed as commanded on the Cycle Interface. Run is not issued during any manual functions, such as Forward and Return.

6.4.7 Home

Connector - TRANS X10
Pin - 8
Status - Normally open
Type - Output #14 from TRANS

The Home output indicates that the slide is in a position where the tool is clear of the workpiece, therefore a part transfer is possible. It is related to the Home Limit switch and indicates that the slide is at or behind the home position. The following conditions must also be satisfied.

1. Reference position is known (homing done since last reset).
2. Slide is stopped and in position.
3. No program is being executed.

6.4.8 Power Interrupt

Connector - TRANS X10
Pin - 7
Status - Normally open
Type - Output #13 from TRANS

When power is re-applied after a failure, this signal is issued by the TRANS to indicate that an operation (Manual or Automatic) had been interrupted by a power failure. This signal is provided for the machine builder's use in determining the problem. The response will depend on the design of the overall transfer line system. See Section 6.13 for a discussion of power interrupt handling in the TRANS.

Power Interrupt is issued only when Automatic mode has been selected on the Cycle Interface. This signal is dropped whenever homing is completed or the Reset key is pressed.

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6.4.9 Fault

Connector - TRANS X10
Pin - 6
Status - Normally closed
Type - Output #12 from TRANS

In both Automatic and Manual Modes, loss of the $\overline{\text{Fault}}$ output is indicated when the TRANS has diagnosed a malfunction. This signal indicates that the respective unit is not operational. When a fault occurs, an operator must determine and resolve the problem utilizing the diagnostic display capabilities of the TRANS, then reset the TRANS, homing the axis if necessary in order to bring it to Ready status once more.

6.5 BRAKE OUTPUT

Connector - TRANS X10
Pin - 5
Status - Normally open
Type - Output #11 from TRANS

This output is a signal from the TRANS to release the servomotor brake (if included). It is wired directly to a relay that controls the electrically lifted motor brake.

When the TRANS has control of the system, it issues the brake output and the brake must be lifted to allow motor operation. If the TRANS detects a fault or is placed in programming mode, it drops this output, relinquishing control of the motor. The brake must then be applied.

The machine builder must wire this output to a 24V relay. The normally open contact from that relay is wired into the brake circuit, the location depending on the type of Indramat servo controller (e.g., TDM, DSC) being used in the system. Refer to your system interconnect diagram for wiring details.

This signal is not handled internally in the Indramat control circuitry because of the wide variation in servomotors (brake current requirements) available. This method allows proper relay sizing for the individual application.

6.6 CONDITIONAL JUMP INPUTS

Conditional Pins - TRANS X11
- Bit 3 - 5
- Bit 2 - 6
- Bit 1 - 7
- Bit 0 - 8

Status - Normally open
Type - Inputs #21, #22, #23, #24 to TRANS

Four inputs for conditional jumps are provided on the TRANS interface. Up to 16 different program jumps can be performed using the 4 bits of the conditional jump control signal. These could be used to call up various part programs or reverse programs stored in the TRANS. These lines could be wired to a selector switch or tied to the Line Control.

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NOTE: If the system uses the Line Control Adaptor, (LCA), parameter P04 specifies from where these conditional jump inputs will be accepted. P04 = 0 specifies to accept the inputs from the TRANS interface, connector X11. P04 = 1 specifies to accept the inputs only from the serial TRANS-BUS (LCA).

6.7 PRIMARY OVERTRAVEL LIMIT SWITCHES

Connector - TRANS X8
Pins - Positive direction - 8
- Negative direction - 7
Status - Normally closed
Type - Inputs #9, 10 to TRANS

Two hardware overtravel limit switch inputs are provided. If desired, the machine builder will wire these to physical travel limit switches on the machine. This may be desirable, because the software travel limits are not active until a homing cycle is performed. Prior to that time, the axis could be manually jogged (via TAM panel controls only) past the software limits.

These inputs must be tied to +24 volts if unused.

6.8 HOME LIMIT SWITCH

Connector - TRANS X8
Pin - 6
Status - Normally open
Type - Input #11 to TRANS

This switch is closed when the slide is physically at the home position. See Section 7.4 for a detailed discussion of Home Limit switch installation. Because the TRANS performs time-critical monitoring of this switch, it must be wired Directly To The Input, not through other logic.

6.9 EMERGENCY STOP CIRCUIT

The TRANS normally includes an emergency stop circuit for protection of both the equipment and operating personnel. Figure 6-1 illustrates a typical circuit. Following paragraphs describe the signals input to the TRANS from the machine.

Refer to Figure 6-1. Relay CR1 opens whenever the EMERGENCY STOP button is pressed, the Safety Limit switch is opened, or the TRANS detects a fault. CR1 is a 24V relay with a normally open contact which controls the power relay which switches three phase power to the servo controller.

It is important to connect pin 6 of X8 directly to a 24V relay with no interruption in the circuit. This is necessary to ensure that the TRANS will always detect when three phase power has been dropped.

Note that there are no semiconductor devices in this circuit. The only reason the emergency stop circuit is wired into the TRANS is so that the TRANS can 1) detect that power to the drive has been dropped and the drive will not respond to any command, and 2) to determine and display the appropriate diagnostic.

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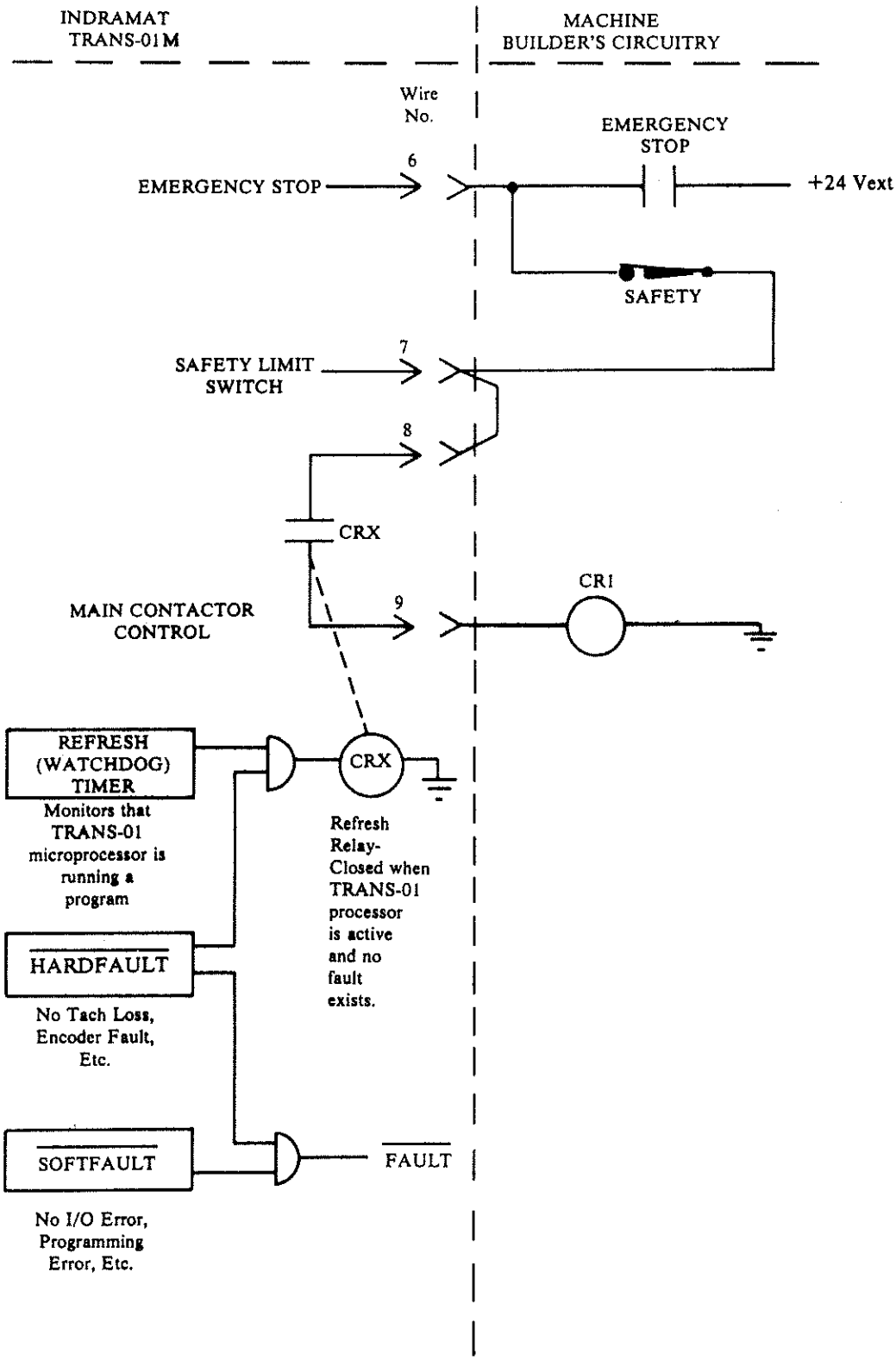


Figure 6-1. Typical Emergency Stop Circuit

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6.9.1 Emergency Stop

Connector - TRANS X8
Pin - 4
Status - Normally closed
Type - Input #13 to TRANS

This signal is normally supplied by the machine builder, depending on the emergency stop design for the system. If this line opens, the relay for main power to the servo controller opens, dropping power to the motor and controller. If this input is not provided, the machine builder must wire pin 4 to +24 volts.

6.9.2 Safety Limit Switch

Connector - TRANS X8
Pin - 4 and 5
Status - Normally closed
Type - Input #12 to TRANS

This signal is normally supplied as a part of the emergency stop circuit. The normally closed contact will be opened if the slide reaches its secondary (emergency) overtravel limit. This signal is normally supplied by the machine builder, depending on the emergency stop design for the system. If this line opens, the main power relay to the servo controller opens, dropping power to the motor and controller. In this situation, the axis cannot be jogged, but must be manually cranked off the limit switch.

If this input is not provided, the machine builder must wire pins 4 and 5 to X9 pin 9. See Section 7.5.3 for a discussion of installation considerations for this switch.

6.9.3 Main Contactor Control

Connector - TRANS X9
Pin - 10
Status - Normally open
Type - Output from TRANS

6.10 AUXILIARY FUNCTIONS

6.10.1 Auxiliary Function Outputs

Connector - TRANS X10
Pins - Auxiliary function 0 - 18
- Auxiliary function 1 - 17
- Auxiliary function 2 - 16
- Auxiliary function 3 - 15
- Auxiliary function 4 - 14
- Auxiliary function 5 - 13
- Auxiliary function 6 - 12
- Auxiliary function 7 - 11

Status - Normally open
Type - Outputs # 17-24 for TRANS

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These programmable output signals are provided by the TRANS and can be tailored to the user's needs for any additional status signals, such as "Full Depth", "In Toolchange Position", etc. They are also used for clamping, spindle control, tool expansion, etc.

Outputs are +24 Vdc, 150 mA per output, short circuit protected, optically isolated from internal circuitry.

Note that each auxiliary function has an associated acknowledgment input. When an auxiliary function is turned on or off, an acknowledgment is required, because the control issues the output, then waits for the acknowledgment before continuing with its cycle. See Section 6.10.3 for guidelines (and timing) for use of auxiliary outputs and acknowledgments.

6.10.2 Auxiliary Acknowledgments

Connector	- TRANS X8
Pins	- Acknowledgment 0 - 16
	- Acknowledgment 1 - 15
	- Acknowledgment 2 - 14
	- Acknowledgment 3 - 13
	- Acknowledgment 4 - 12
	- Acknowledgment 5 - 11
	- Acknowledgment 6 - 10
	- Acknowledgment 7 - 9
Status	- Normally open
Type	- Inputs # 1-8 to TRANS

Each of the acknowledgment inputs is associated with a corresponding auxiliary function. When that function line is turned on or off under program control, an acknowledgment of that action must be returned to the TRANS for programmed operations to continue. Once an acknowledgment is issued, it must remain unchanged in that state until the corresponding auxiliary function output is changed. Otherwise, a soft fault will occur.

NOTE: If the system uses the Line Control Adaptor (LCA), parameter P03 specifies from where the acknowledgments will be accepted. P03 = 0 specifies the TRANS interface, connector X8. P03 = 1 specifies accept the acknowledgment inputs only from the serial TRANS-BUS (LCA).

6.10.3 Line Control Interface Guidelines

In most cases the customer's host control for the TRANS is a programmable controller. This paragraph provides helpful hints on using the programmable controller with auxiliary function outputs and acknowledgments.

Figure 6-2 is an example of timing for auxiliary functions.

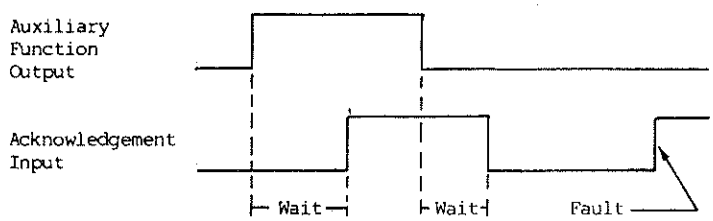


Figure 6-2. Example of Auxiliary Function Timing

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Required Sequence

1. Turn on an auxiliary function output.
2. TRANS waits until an acknowledgment is received.
3. Turn auxiliary function output off.
4. TRANS waits until an acknowledgment is received, then continues its processing.

Note that the constraint is that the state of an auxiliary output is changed, then the change must be acknowledged. A change in an acknowledgment level must always be preceded by a change in the auxiliary output. Figure 6-2 illustrates how an acknowledgment without a request is diagnosed as a fault.

EXAMPLE: The system moves at rapid feedrate into position to cut a part and clamps the workpiece during the rapid movement to save time. Prior to cutting, an auxiliary output is issued to verify that the clamp is down. An acknowledgment will allow cutting to proceed. Note that if the acknowledgment is issued as soon as the clamp is down, it may be diagnosed as a fault. It must not be given until the TRANS requests it (via auxiliary output) and the clamp is down.

In your programmable controller, we suggest use of a contact which is closed when an auxiliary output is issued. By placing this contact in the ladder rung where the associated acknowledgment is generated, you enable the acknowledgment by closing a contact in series with it. Thus, the acknowledgment never comes on before it is requested and goes off immediately when the auxiliary output is dropped.

Of course, this may not apply in all cases. If necessary, you can bridge the auxiliary output contact to prevent the acknowledgment from turning off until the proper conditions have occurred.

6.11 BCD CODED OUTPUTS

Connector	- TRANS X9
Pins	- Units bit 1 - 1
	- Units bit 2 - 2
	- Units bit 4 - 3
	- Units bit 8 - 4
	- Tens bit 1 - 5
	- Tens bit 2 - 6
	- Tens bit 4 - 7
	- Tens bit 8 - 8
Status	- Normally open
Type	- Outputs # 1-8 from TRANS

These BCD coded outputs can be used to energize multi-speed motors, energize reversing contactors, communicate to a line controller, etc.

The outputs are +24 Vdc, 50 mA per output, optically isolated from internal circuitry.

Example: If BCD output 01 is programmed, pin 1 of X9 is high, all other lines are low.

6.12 SPINDLE CONTROL SIGNALS

This paragraph describes the TRANS control interface for a spindle. Note that spindle operation is enabled using parameter P40.

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6.12.1 Operating Conditions -- Spindle Ready Status - Bb

Connector - X8
Pin - 2
Status - Normally open
Type - Input #15 to TRANS

If spindle analog output is selected in parameter P40, the Ready status signal (Bb) of the feed drive and also the Ready status of the spindle drive (Bb) must be transmitted to the TRANS. The diagnostic message SPINDLE NOT READY is displayed if the Spindle Ready signal is not received by the TRANS.

Note that when the TRANS is first started up, the Spindle Enable (RF signal) is not sent.

6.12.2 Spindle Command and Enable Signals

Spindle Command

Connector - X3
Pin - 1
Status - Normally open
Type - Output from TRANS

Spindle Command Ov

Connector - X3
Pin - 2
Status - Normally open
Type - Output from TRANS

Spindle Enable

Connector - X3
Pin - 3
Status - Normally open
Type - Output from TRANS

When a program block containing a spindle rpm value is executed, an analog voltage proportional to that rpm and direction is output to the spindle controller (starting from the beginning of execution of the block). The Spindle Enable is simultaneously turned on.

If a spindle rpm value of 0 is programmed, upon execution of that block, the TRANS first switches off the analog voltage (0 volt output), then waits for receipt of the N-actual = N-command input. One hundred msec after receipt of that signal, the TRANS turns the Spindle Enable signal off.

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6.12.3 N-actual = N-commanded

Connector - X11
Pin - 15
Status - Normally open
Type - Input #31 to TRANS

This signal is sent by the spindle controller to signify to the TRANS that the spindle has reached the commanded speed.

0 V = Command rpm not reached
24 V = Command rpm reached

Once a spindle speed is commanded, the TRANS executes no feed axis movement as long as this signal is not present. During this time, the diagnostic N <> CMD appears in the TAM display. Feed movement will be continued as soon as the signal is sent.

Exceptions:

1. Rapid traverse motions, which are blocks in which the underlying rapid traverse is programmed as the speed, are executed regardless of the status of N-actual = N-command.

2. This signal is not required for reverse programs to be executed. This allows the spindle to run up to speed without any delay during the rapid traverse feed motion.

   Also this allows the feed slide to be moved to the home position via the reverse program if the spindle is defective.

It is imperative that the spindle controller be able to output +24 volts to the TRANS both for proper operation of the program and to determine the status of the spindle motor.

6.12.4 Spindle Enable - Manual Mode

Connector - X11
Pin - 14
Status - Normally open
Type - Input #30 from TRANS

When the TRANS is in Automatic Mode, program execution can only occur if the connected spindle controller is operational and returning the Spindle Ready (X8-2) signal.

The Spindle Enable - Manual Mode signal is issued to enable spindle operation when the TRANS is in Manual Mode. Thus, it is possible to test programs in Manual Mode during their development. The spindle may be run in Manual Mode and will follow the program profile (starts and stops) when this signal is applied.

Also, if the spindle is defective, the Spindle Not Ready diagnostic error can be overridden by issuing this signal, allowing the feed axis to be returned to the Home position.

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6.12.5 Spindle Temperature Switch - TAS 2

Connector - X11
Pin - 16
Status - Normally open
Type - Input #32 to TRANS

When the spindle is enabled by parameter P40, there must be a voltage available at this input, indicating proper spindle temperature conditions, for operations to occur. If this input is not present, the SPINDLE OVERTEMP diagnostic message is displayed on the TAM.

If this signal drops during a program cycle, the cycle is not interrupted and the diagnostic message does not appear until the cycle is ended.

If the spindle does not have a temperature switch, then this input must be wired to +24 volts for proper TRANS operation.

6.13 POWER INTERRUPT HANDLING

The TRANS features an advanced power interrupt handling feature that ensures rapid accurate recovery from power outtages and emergency return conditions.

The sequence which is followed is:

1. TRANS senses loss of power.

2. If the motor is running the TRANS immediately commands it to stop (step command) so the stopped position can be read and stored before power is completely lost and the encoder can no longer be read.

3. All variable conditions are stored including: currently selected reverse vector, status of auxiliary outputs and status of BCD outputs.

4. When power is re-applied, the TRANS restores the variable conditions to their previous state, except all outputs are off. The Power Interrupt output is issued and the TRANS awaits a Homing (Automatic) or Return (Manual) signal. It will accept no other commands.

5. When a Homing or Return command is received, the TRANS first sets the auxiliary outputs to their last known state.

6. It then takes a "conditional look" at the current reverse vector block.

    a. If that block contains only auxiliary function changes -- no homing or other motion commands -- the TRANS does not wait for any pending acknowledgments of the restored auxiliary outputs, but jumps to and executes the reverse vector block, setting the auxiliary outputs as defined in that block. It then waits for acknowledgments to these new auxiliary outputs before continuing with the reverse program.

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This gives the user a chance to match outputs and acknowledgments on power fail recovery. The easiest way to do this is to program the first block in the reverse program (usually 120) to turn off all auxiliary outputs, then program the next block with a homing function. If the system follows the line control guidelines discussed in Section 6.10.3, that would automatically turn all acknowledgments off and the TRANS would proceed.

Of course, you must be certain that axis movement is possible and safe with the auxiliary output setting you select.

b. If the first block of the reverse program contains any function other than auxiliary output changes, the TRANS waits for acknowledgments to the restored auxiliary outputs. Once the correct acknowledgments are received, the first block of the reverse program is executed.

7. Normal program operation then continues.

6.14 SIGNALS ADDED TO TRANS WITH HARDWARE OPTIONS

Two signals, Thrust Missing and Excessive Thrust, are added to the interface when the Feed Adaption option is installed. They are described in Section 9.5.3.

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CHAPTER 7. MOUNTING AND INSTALLATION

7.1 GENERAL

The use of completely interchangeable functional modules is an unconditional requirement for highest operating uptime of any machine.

The INDRAMAT TRANS-01 M control and drive package consists of only a few modules. Highly developed technology has enabled standardization of these modules regardless of the different details of various applications. In the case of a malfunction, the diagnostic system will indicate the defective unit, which then can be replaced without complicated adjustments.

This technique was developed because analysis showed that this is the only way complex systems can be operated with minimum down time. This analysis proved that the majority of down time is spent finding problems and correcting details. Often the actual time consuming problems are caused by detailed trouble-shooting, where measures are taken whose indirect effects are not recognized (such as adjustments required, but not made).

INDRAMAT's Modular TRANS control package offers a perfect solution to this trouble-shooting problem. However, this concept will work only when the machine design and installation also provides quick and failsafe mechanical interchangeability of the modules without the danger of damage or changes in the machining results.

Cables with connectors should also be installed in such a manner that complete replacement is possible. (Note that Indramat can supply complete interconnect cable sets.)

It is the responsibility of the machine builder to minimize downtime through quick and failsafe module interchangeability.

7.2 ARRANGEMENT AND INSTALLATION OF ELECTRICAL EQUIPMENT

7.2.1 Distributed Control

INDRAMAT's Modular TRANS-01 system is designed employing the principle of distributed control.

The AC servo controller and TRANS-01 M control a feed axis and spindle on a single unit and are designed to be mounted in a sealed cabinet on or near the machine.

Advantages of this distributed control principle are:

* Cables are kept short.

* Because of the high performance available in the system, it is possible to standardize the transfer units.

* Critical signal cables, such as the position feedback cable, do not have to be routed through the entire machine, thereby eliminating the noise problems normally encountered with such cables.

* The transfer unit can be operated independently and therefore can be tested separately from the rest of the transfer-line system.

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7.2.2 Mounting Considerations

The following points must be taken into consideration during installation:

* The Modular TRANS, servo controller and spindle controller are mounted in a sealed cabinet and are generally powered from a single power supply.

* The fixed TAM (TAM 2.01) is protected by a sturdy lockable cover containing a window through which the display can be viewed. Thus, it does not require mounting in a separate cabinet. The TAM can be daisy-chained to up to then TRANS controls. The maximum length of the serial channel cable is 80 feet starting from the farthest connected TRANS-01 M to the TAM.

* The TRANS-01 M must be mounted to allow a minimum of 3 inches top and bottom for cable clearance.

For suitable mounting procedures, refer to the outline and mounting diagrams on the following pages. They are:

* Figure 7-1. TRANS-01 M Outline Drawing

* Figure 7-2. TAM 2.01 (Fixed TAM) Outline Drawing

* Figure 7-3. TAM 2 (Portable TAM) Outline Drawing

7.2.3 Heat Dissipation

Under worst case conditions, the servo controller dissipates up to 300 watts; thus, the installation must insure that sufficient cooling can take place.

The power transformer should be arranged so that it will not cause heating of the AC servo controller or the TRANS-01 M in the control cabinet.

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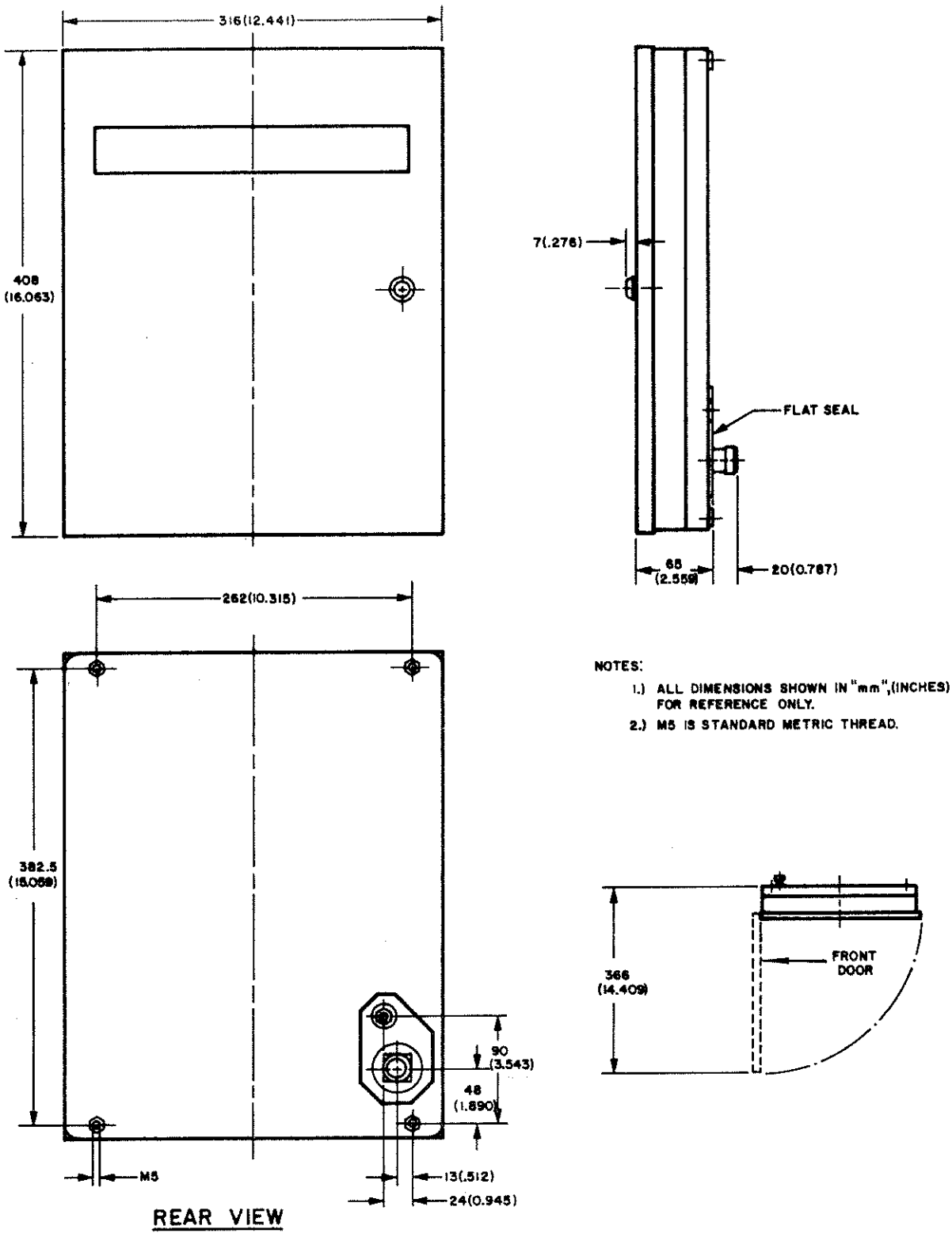


Figure 7-2. TAM 2.01 (Fixed TAM) Outline Drawing

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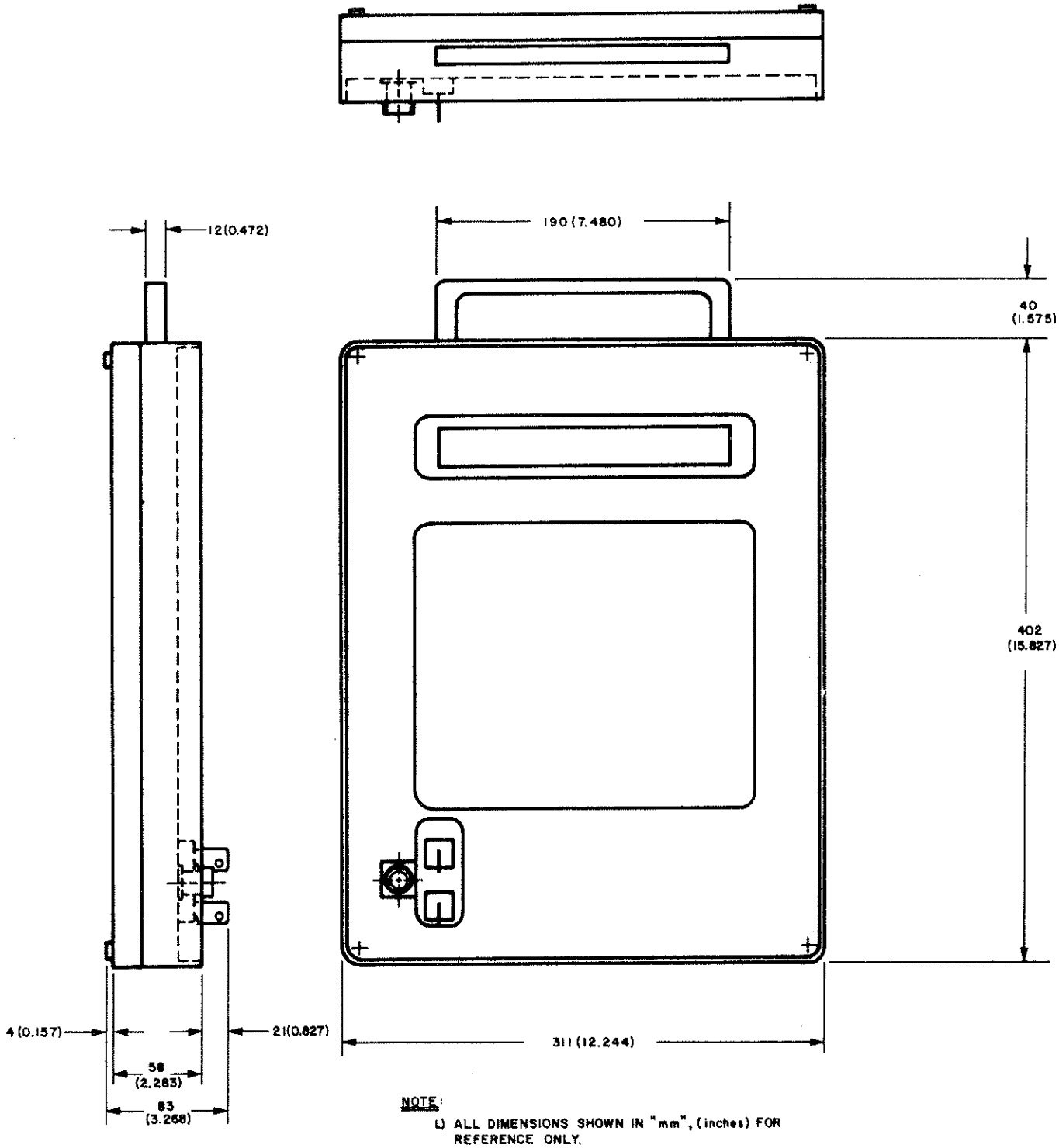


Figure 7-3. TAM-2 (Portable TAM) Outline Drawing

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7.2.4 Requirement For External Voltage Source

The TRANS provides the highest possible noise immunity. All inputs and outputs, including the drive interface, are both physically and electrically isolated from internal circuits. Thus, I/O signals require the use of an external voltage source, provided by the machine builder. See the interconnect drawing, Figure 7-4, and typical I/O circuit diagram, Figure 7-8.

7.2.5 Rules For Installation

For highest reliability, the installation should be made according to the rules listed below. This avoids not-so-obvious noise sources.

* Feedback cables must be shielded and routed as directly as possible. In no instance may these cables be routed along side of and parallel to power switching cables.

* Inductive loads (such as solenoids and motors) that are switched at the unit must be suppressed with R-C networks (AC) or diodes (DC).

* I/O cables which are routed through the machine (e.g., the cycle interface inputs and outputs) must be shielded.

Refer to the interconnect drawings supplied by Indramat for details on cabling for your particular system.

7.3 MOUNTING THE SERVO MOTOR

The mounting arrangement of the MAC servomotor must be designed so that, if motors are exchanged, the previous relationship between the slide position and the motor shaft position is guaranteed. If this is not taken into consideration, changing motors could cause an offset in all programmed positions. For further details, refer to Section 7.4 below.

In order to prevent damage to the motor bearings from excessive forces, the motor coupling to the machine must provide radial and axial compensation. In addition to the component tolerances, at least +/- 0.040 inches (+/- 1 mm) axial compensation should be provided. This is needed to prevent damage to motor bearings from motor heat expansion, machine heat expansion or axial motion of machine parts.

If a MAC motor is direct-coupled to the ballscrew, our experience has shown that use of bellow-type servo coupling, such as Jakob couplings, is best.

If gearing is used, the required compensation can be obtained by directly mounting the input gear to the motor shaft without extra bearings supporting this gear. Keep in mind that this driver gear, and its mating driven gear, should be marked so that the motor shaft/ballscrew relationship is maintained as mentioned earlier. Note that spiral gears are undesirable because they cause axial loads and position displacement.

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7.4 ESTABLISHING A REFERENCE POSITION

7.4.1 General

The TRANS utilizes a digital incremental feedback device to obtain position information. The preferable method of determining slide position is to utilize the MAC servomotor's integral incremental encoder. An alternative method is to measure position via an incremental linear scale.

When supply voltage is lost, the TRANS stores the last known motor position, however, because of motor coasting, the exact position of the axis must be re-established after each power loss, using the Homing instruction which moves the slide to the reference position.

Using the operator and cycle interfaces, any of the following methods may be used to move the slide to the reference position (home):

* At the programming level -- by programming a homing instruction anywhere in the program.

* At the toolsetter level -- via the TAM keyboard or at the operator level discussed below.

* At the operator level -- by switching the control to manual and using the RETURN pushbutton to execute the Reverse program.

* Via the cycle interface -- by issuing the Homing input signal.

7.4.2 Reference (Homing) Procedure

The TRANS responds to a homing command in one of two ways:

1. After a power up or Reset (clear "Hard" errors), the TRANS goes through the complete procedure described below.

2. Once the first homing function is performed, the TRANS remembers where home is. A subsequent homing command causes the slide to return to the original home position without repeating the complete physical homing procedure. It merely checks that the zero (or marker) pulse occurs as expected. The HOME SWITCH ERROR occurs if the Home Limit switch closes at a point other than the expected home position.

Homing Procedure

1. Homing command is issued.

2. If the slide is not on the Home limit switch it moves in "reverse" toward home until the switch closes as shown in the motion profile in Figure 7-5. It then decelerates, reverses direction and moves "forward" off the switch. If the slide is already on the switch when the command is issued, it moves forward off the switch.

   The axis moves at one of two feedrates:

   a. After a Reset, after a power up and for the first homing only, the axis moves at the homing speed specified in parameter P15.

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b. On all homing operations after the first homing, the axis moves at the feedrate specified in the homing command. If no feedrate is specified in the command, the slide moves at the homing speed specified in parameter P15.

3. The axis decelerates, reverses direction and creeps in the "reverse" direction until the Home Limit switch closes.

4. It continues in the "reverse" direction at a super creep rate until the zero (or marker) pulse occurs.

5. The axis then moves "forward" until it is exactly on the marker pulse (about 10o of revolution).

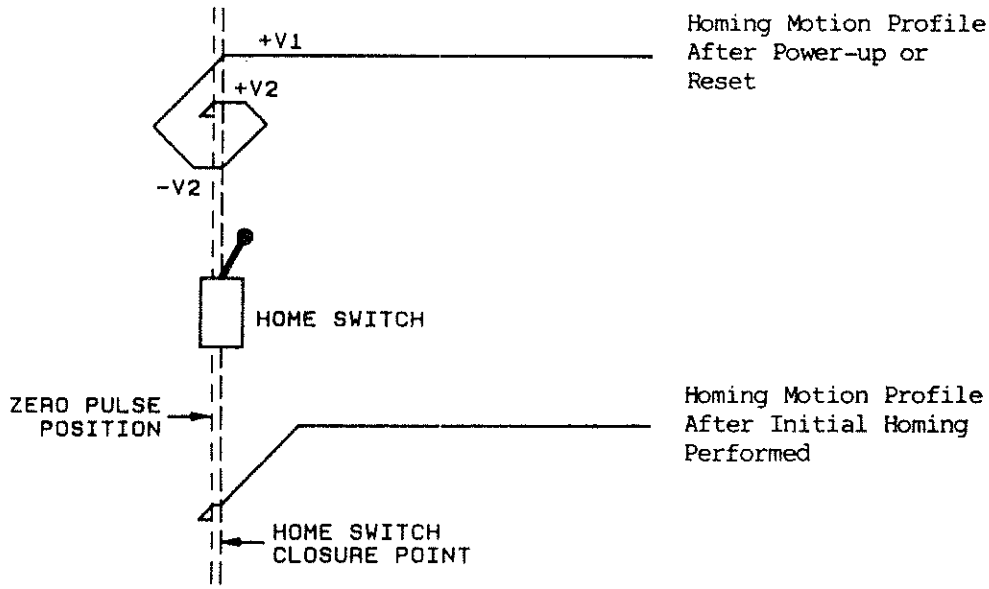


Figure 7-5. Homing Motion Profile

The zero pulse appears once in each motor revolution. The function of the Home Limit switch is to indicate the specific motor revolution in which the zero pulse is used.

In the homing procedure, regardless of the beginning position, the slide must stop on the Home Limit switch, closing it. The next zero pulse after the closing of the Home Limit switch indicates the reference position.

In many cases, some position other than home, such as the center line of the transfer bar, is used as the reference position for machining. All programmed distances are then specified in reference to this point. This is established by entering the distance from home to the new reference location as the Reference Position parameter P12. (See Section 4.4 for details on parameter entry.) When the control is homed, this value will be loaded into the position counter, and all moves will be made in reference to this position. This is illustrated in Figure 7-6, Transfer Unit Design Criteria.

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7.4.3 Slide Mechanics Requirements

NOTE

Because all program dimensions are measured in relation to the reference position, they depend on the location of both the home limit switch and the zero (marker) pulse. Thus, the machine builder must insure that the ballscrew/zero pulse orientation is maintained if the motor is replaced.

To guarantee that this can be performed in a failsafe manner, and to prevent unnecessary downtime after changing motors, the zero pulse position on INDRAMAT's MAC motor has been standardized to a certain keyway/motor frame orientation. There is a 10 degree difference between the keyway and the center line of the motor. That is the zero point.

The machine design must insure that the motor is always coupled to the ballscrew with the same orientation. The most reliable way is through a mechanical design that allows only one orientation. If this is not done, the machine should be clearly labeled as such and marked (e.g., gearteeth) to guarantee correct coupling of the motor.

For the same reason, if the machine is ever disassembled, the actual reference position must be measured after start-up and the reference position parameter edited accordingly.

7.4.4 Placement of the Reference Position

Because the transfer unit must be able to move to the reference (home) position at any time, this position must be located at a point where the tool is out of and at a safe distance from the workpiece.

However, the reference position should not be placed too far back from the workpiece in order to enable reference checking during operation without waste of machining time. It is advantageous when the reference position can also be used as the starting point of the machining cycle, to check that the slide indeed is returned (in case of drive train breakage).

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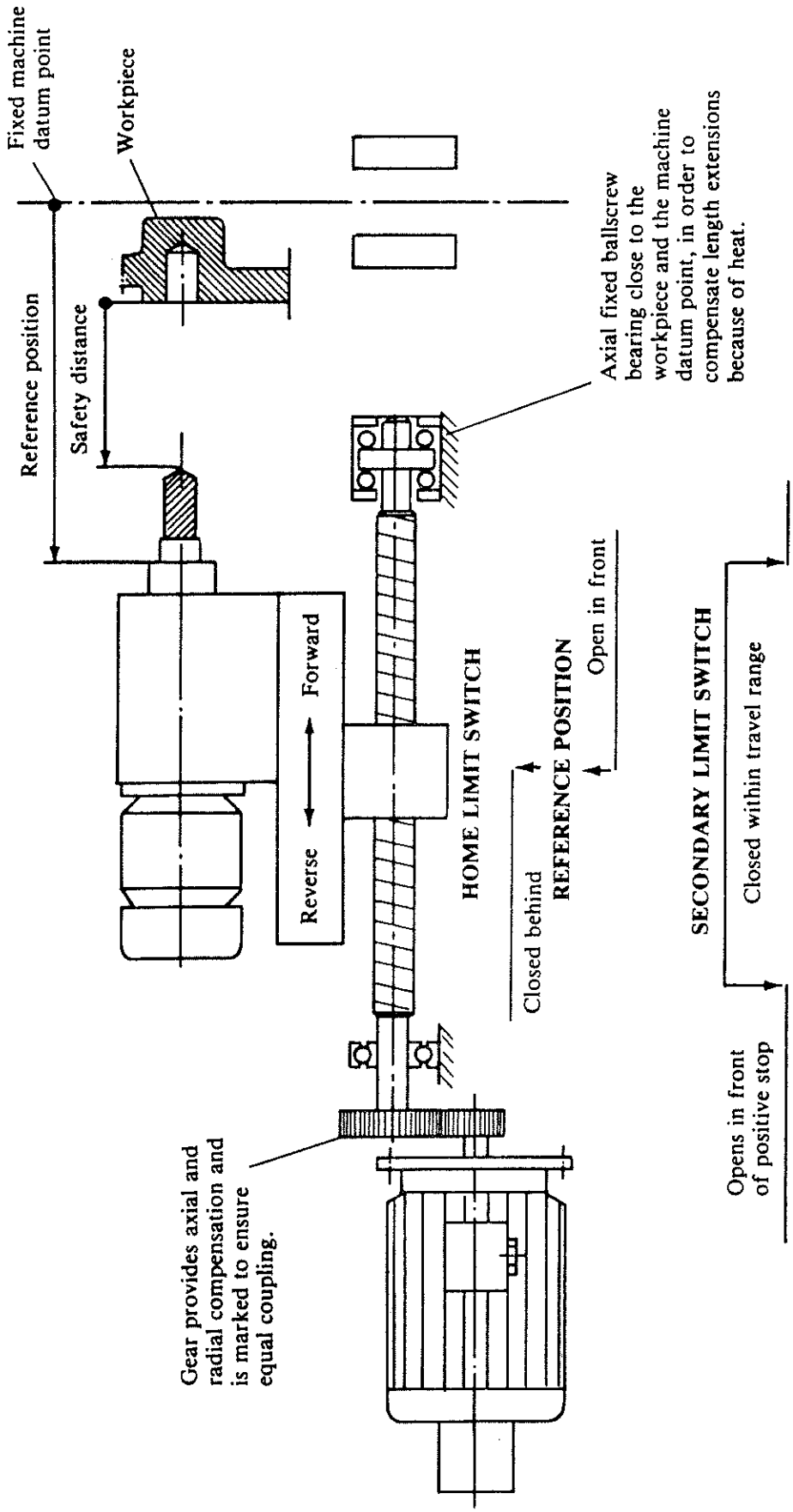


Figure 7-6. Transfer Unit Design Criteria

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7.4.5 Positioning the Home Limit Switch

As described earlier, the Home Limit switch indicates to the TRANS that the reference position is located at the next zero pulse after actuation of the limit switch. Therefore, the reference position can be adjusted in increments of one motor revolution by moving the Home Limit switch.

Note however, that problems may arise when the limit switch is located in a position near to where the zero pulse occurs. In this situation, switching tolerances such as contact-bounce may cause irregular reference positions, sometimes not capturing the first zero pulse.

To prevent this from occurring, the TRANS monitors the distance between limit switch contact closure and the zero pulse. If the switching point is closer than one-quarter of a revolution to the marker pulse, the home cycle is aborted and the
OPT 0 POS Dists =+/-X.XXX diagnostic message is displayed. If this occurs, the Reset key is also lighted to indicate a hard error.

7.4.6 Actuating the Home Limit Switch

Actuation of the Home Limit switch must be arranged so that the switch contact is closed as the unit travels back away from the workpiece. See Figure 7-6.

The dog used to activate this switch must be long enough to maintain contact closure from the reference position all the way back to the - travel limit if parameter P23 is a "1" or the + travel limit if P23 is a "0".

This is done to indicate to the control in which direction the slide must be moved to reach the reference position. It is also required because the Home Limit switch signal is used to indicate that the tool is clear of the workpiece.

Because the machine design dictates the relationship between motor rotation direction and slide direction, "Homing Direction" has been assigned as a user-entered parameter in the TRANS. See Chapter 4 for details.

7.5 LIMIT SWITCH POSITIONING ON A NUMERICALLY CONTROLLED AXIS

Three types of limit switches may be included in the machine design, as illustrated in Figure 7-7. They are Primary Overtravel Limit switches, Home Limit switch and Safety (Emergency) Limit switch.

7.5.1 Primary Overtravel Limit Switches

These limit switches (G+ and G- in Figure 7-7) are used to inhibit travel against the Safety (Emergency) Limit switch because, once the Emergency Limit switch is activated, the slide must be manually moved. The correct position for the Primary Overtravel switches is then far enough in front of the Emergency Limit switch that the slide can decelerate before actuating the Emergency Limit switch.

In Manual Mode, the axis may be moved off a Primary Overtravel Limit switch by pressing the appropriate Jog pushbutton. If a limit is encountered in Automatic Mode, the program is stopped and the TRAVEL LIMIT diagnostic message is displayed.

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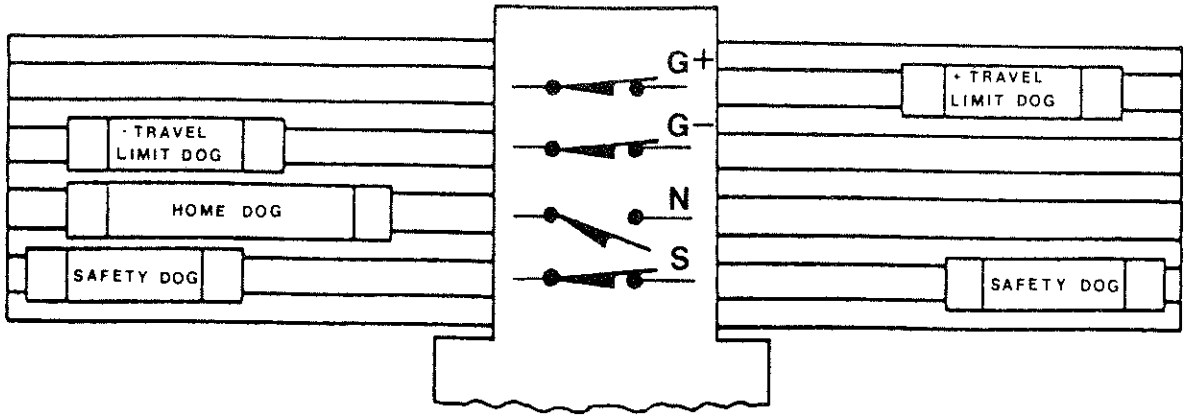


Figure 7-7. Limit Switch Positioning

Programmable travel limits can be substituted for these limit switches, but protection can be assured only after an auto home cycle has been performed. If programmable travel limits are used, some means of manually removing the slide from the Emergency Limit switch must be provided.

7.5.2 Home Limit Switch

As discussed in Section 7.4, the Home Limit switch (N in Figure 7-7) is used to provide a reference when searching for home position. The exact reference is provided by the encoder.

The contacts of the Home Limit switch must indicate what direction (+ or −) the slide is from home at all times. Therefore, the dog must be designed such that reopening of the switch contacts is not possible on the minus side of home.

7.5.3 Safety (Emergency) Limit Switch

The Emergency Limit switch (S in Figure 7-7) is required to prevent moves against the mechanical stops caused by wiring errors during startup, component failures, human errors, etc. This is done by dropping three phase power to the servo controller and actively braking the motor.

The dogs for this switch must be placed far enough from the mechanical stop to provide sufficient time for application of the brake. The switch dogs must be of such a design that it is not possible to reclose the contact by continuing to move after actuating the switch. It is recommended that the dogs be fastened securely, so that inadvertent repositioning is avoided.

During startup, proper operation of this limit switch should be assured before applying power to the slide. As an extra precaution during startup, center the slide unit and position the switch dogs close to the emergency switch. Apply power and run the slide with rapid speed against the limit switch. Note the distance required to stop once the switch is activated. Use this value as a guide when placing the dogs in their final positions.

Figure 7-6 illustrates transfer unit design criteria, including limit switch requirements.

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7.6 TRANS INPUT/OUTPUT CIRCUITS

Various input/output requirements are discussed and illustrated in this paragraph.

1. For high noise immunity, all of the TRANS input/output signals are optically isolated from the internal bus system and must be operated by using an external 24V control voltage source as illustrated in Figure 7-8. This is valid for all I/O including the operator interface, cycle interface and auxiliary functions. Where current requirements are low, the controller's internal 24V supply can be used. Contact Indramat for application guidelines before using this supply. In addition, wire routing considerations are important.

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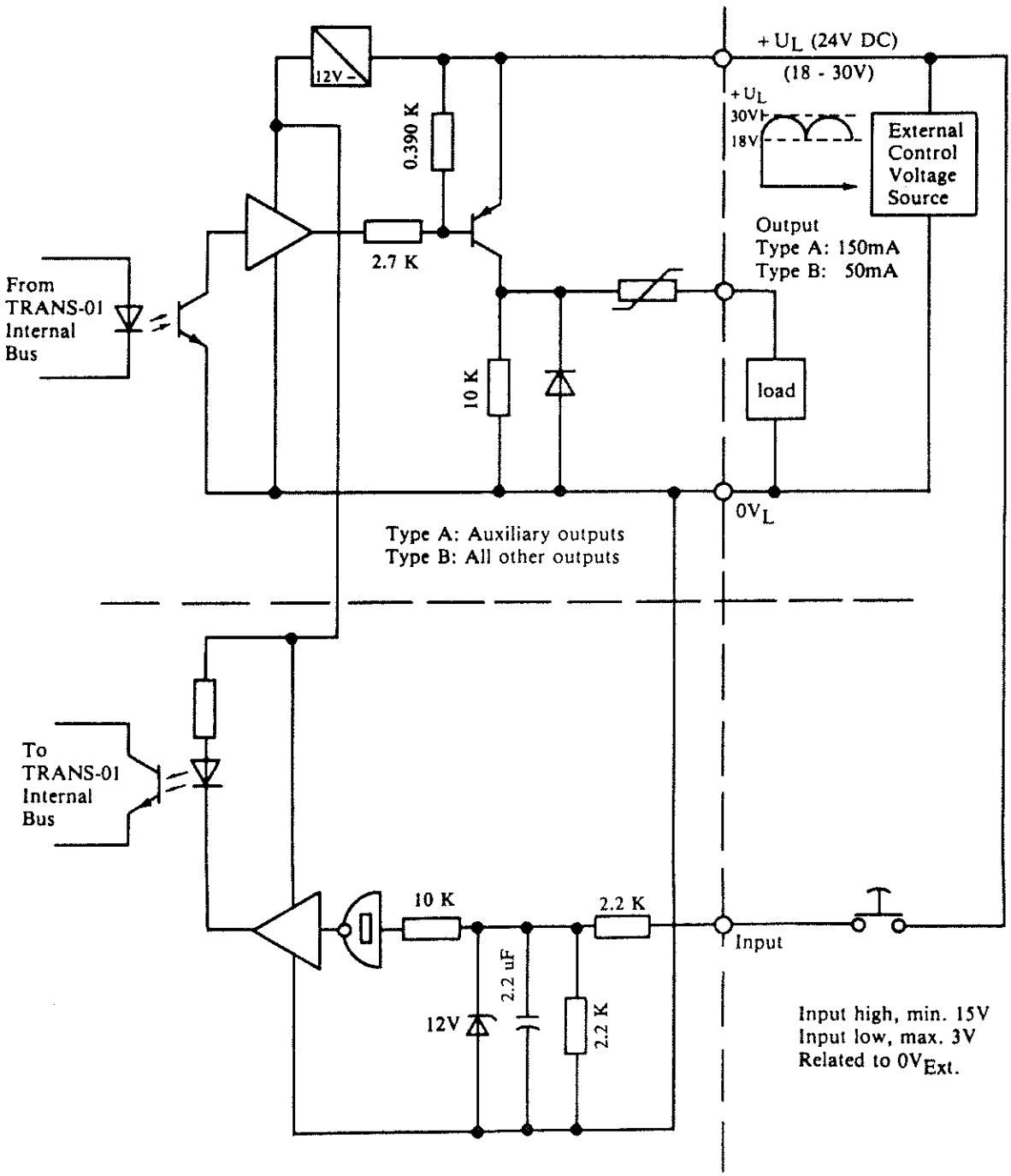
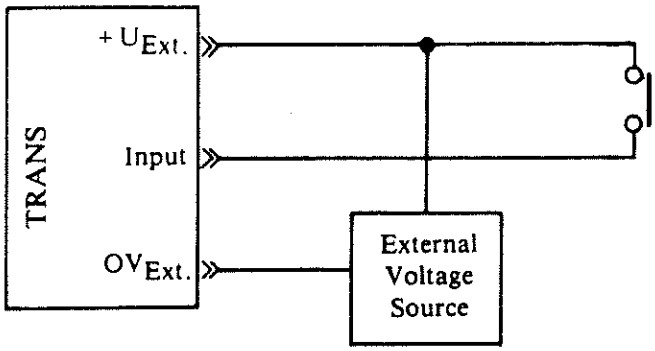


Figure 7-8. Typical TRANS Input/Output Circuits

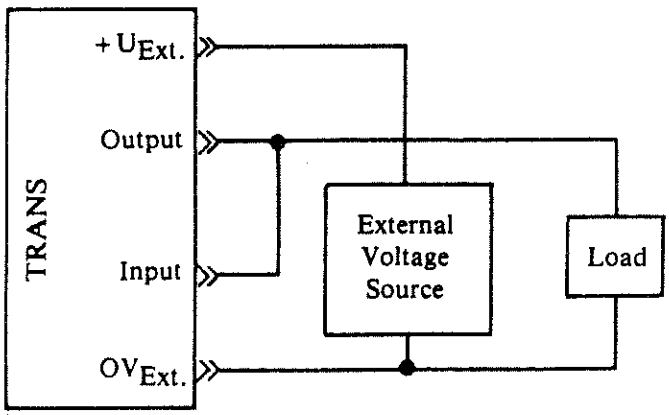
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2. TRANS inputs may be driven directly by TRANS outputs.

3. The sketch below illustrates an input driven by contact.

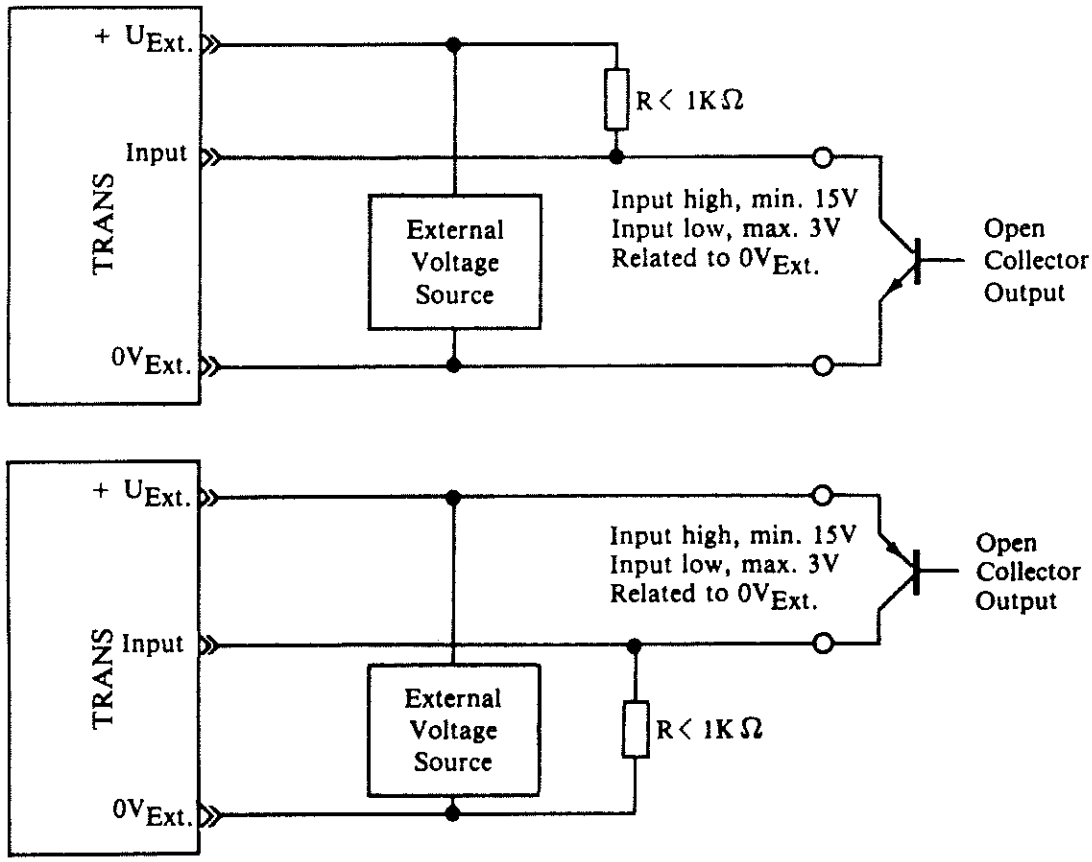


4. Auxiliary function outputs require an acknowledgment signal when used. If no acknowledgment is required for a given function, then tie the auxiliary function output, the acknowledgment input and the load together as illustrated in the sketch below.

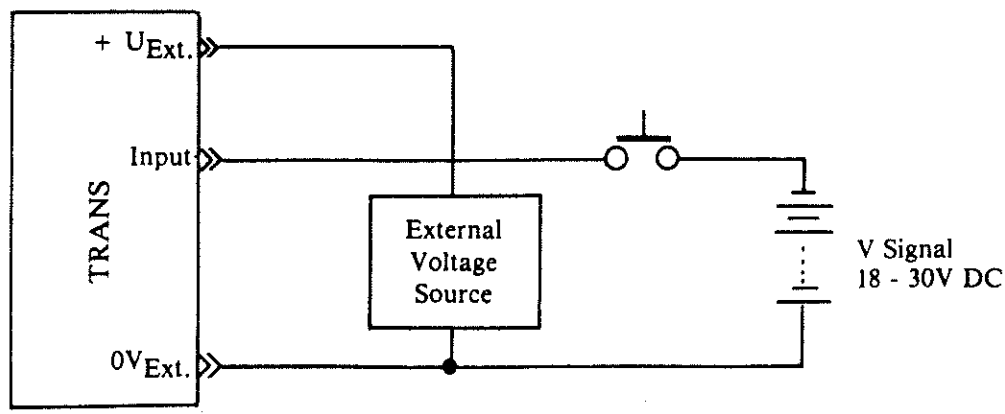


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5. An input driven by an open collector output is illustrated below.



6. An input driven by an active voltage is illustrated below.



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7.7 CHECKOUT MOTOR DIRECTION POLARITY ON START-UP

The motor direction polarity depends on the machine design. Parameter P22 is provided to reverse the direction of polarity if necessary, avoiding the necessity for rewiring.

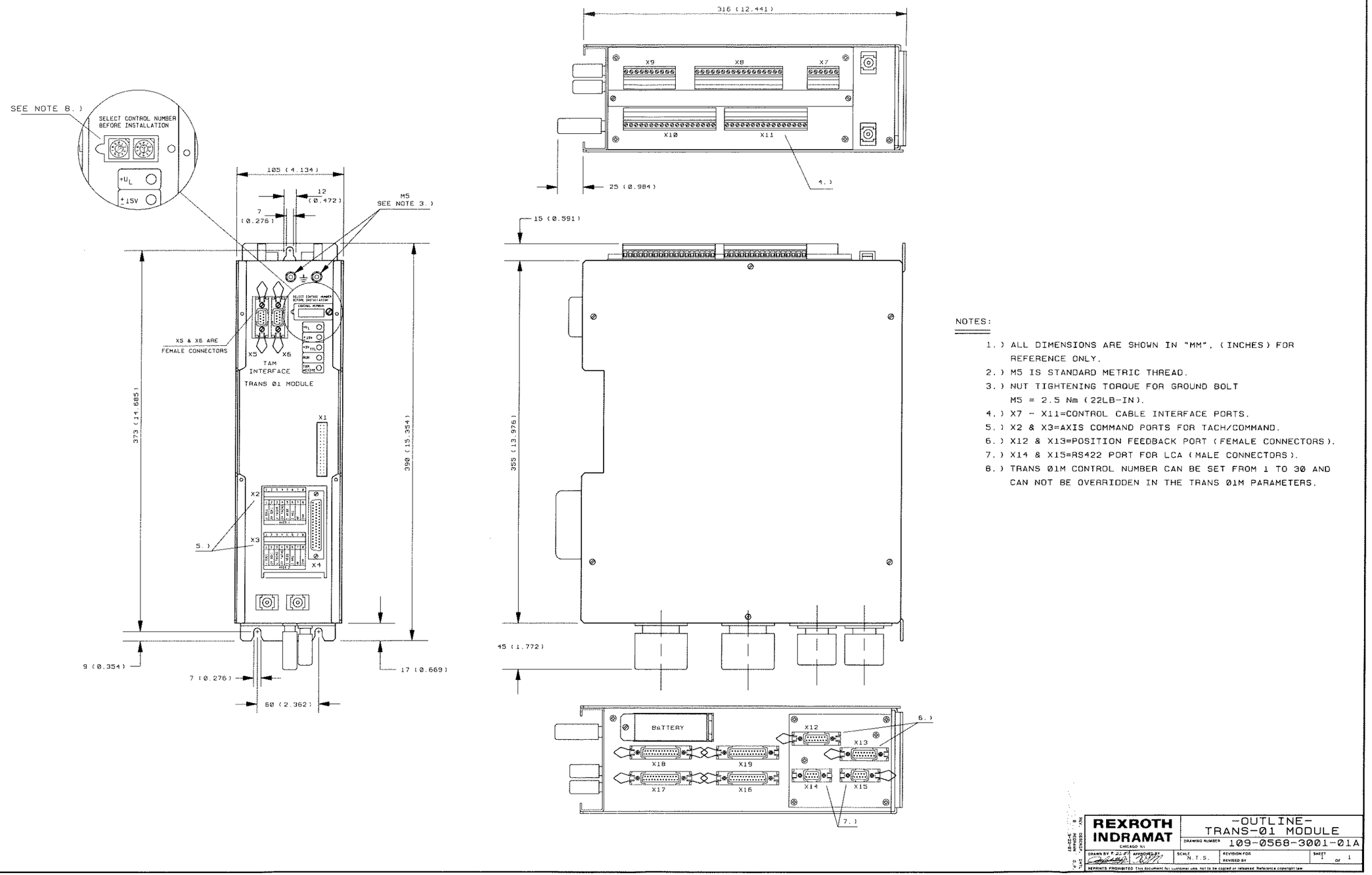
CAUTION

Do not run the servo drive in any mode other than jogging before correct polarity has been determined.

Check out correct direction polarity as follows:

1. After start-up, jog the slide into the center position.
2. Press Reset. 
3. Select Manual Mode at the Operator control panel.
4. Press one of the Jog pushbuttons and observe the direction of slide motion.
5. Compare the actual direction of motion to the polarity of the motion selected.
6. If the observed polarity is opposite to that desired, change Parameter 22 from 0 to 1 or vice versa, to reverse polarity.

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NOTES:

1.) ALL DIMENSIONS ARE SHOWN IN "MM". (INCHES) FOR REFERENCE ONLY.
2.) M5 IS STANDARD METRIC THREAD.
3.) NUT TIGHTENING TORQUE FOR GROUND BOLT M5 = 2.5 Nm (22LB-IN).
4.) X7 - X11=CONTROL CABLE INTERFACE PORTS.
5.) X2 & X3=AXIS COMMAND PORTS FOR TACH/COMMAND.
6.) X12 & X13=POSITION FEEDBACK PORT (FEMALE CONNECTORS).
7.) X14 & X15=RS422 PORT FOR LCA (MALE CONNECTORS).
8.) TRANS Ø1M CONTROL NUMBER CAN BE SET FROM 1 TO 30 AND CAN NOT BE OVERRIDDEN IN THE TRANS Ø1M PARAMETERS.

REXROTH INDRAMAT CHICAGO ILL

-OUTLINE-
TRANS-01 MODULE

DRAWING NUMBER 109-0568-3001-01A

DRAWN BY P.J.F. APPROVED BY
SCALE N.T.S.
REVISION FOR
REVISED BY
SHEET 1 OF 1

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Figure 7-1. TRANS-01 M Outline Drawing

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NOTES:

1.) CONTROL VOLTAGE (115 or 220VAC) MUST MATCH VOLTAGE INPUTS OF TVM(X10), AND ANY BLOWERS.
2.) T1 = 3 PHASE AUTO TRANSFORMER, 220V OUTPUT. USE ISOLATION XFORMER IF 3 PHASE POWER IS NOT REFERENCED TO GROUND
CR1 = AUXILIARY CONTROL RELAY FOR M1 CONTACTOR (24VDC COIL)
CR2 = BRAKE CONTROL RELAY:only req'd if motor has brake (24VDC COIL)
CR3 = TAS RELAY (24VDC COIL)
M1 = MAIN POWER CONTACTOR
F1 = FUSE 3 EA.-(3 PHASE MAIN POWER)
F2 = FUSE 2 EA.-(115/220V-1 PHASE)
3.) MOTOR POWER CABLE WIRE SIZE DEPENDENT UPON MOTOR/TDM COMBINATION.
4.) USE CABLE 03-0201 IF MOTOR HAS BLOWER.
5.) USE CABLE 03-0411 IF MOTOR HAS BLOWER.
6.) 8 AWG MUST BE USED FOR TVM POWER WITH THE FOLLOWING MOTORS.
MAC 112B-1-GD MAC 112C-1-HD
MAC 112C-0-KD MAC 112C-0-ED
MAC 112C-1-KD MAC 112C-1-ED
MAC 112C-0-HD AND ALL MAC 112D's
7.) USE CABLE 05-0500 FOR TAM TO TRANS-01M.
USE CABLE 05-0410 FOR TRANS-01M TO TRANS-01M.
8.) USE CABLE 05-0420 FOR LCA TO TRANS-01M.
9.) ✳ DENOTES CUSTOMER SUPPLIED COMPONENTS.
10.) SUPPLY 24VDC TO AXIS 2 Bb INPUT ON TRANS-01M TO SIGNAL READY CONDITION OF SPINDLE SYSTEM.

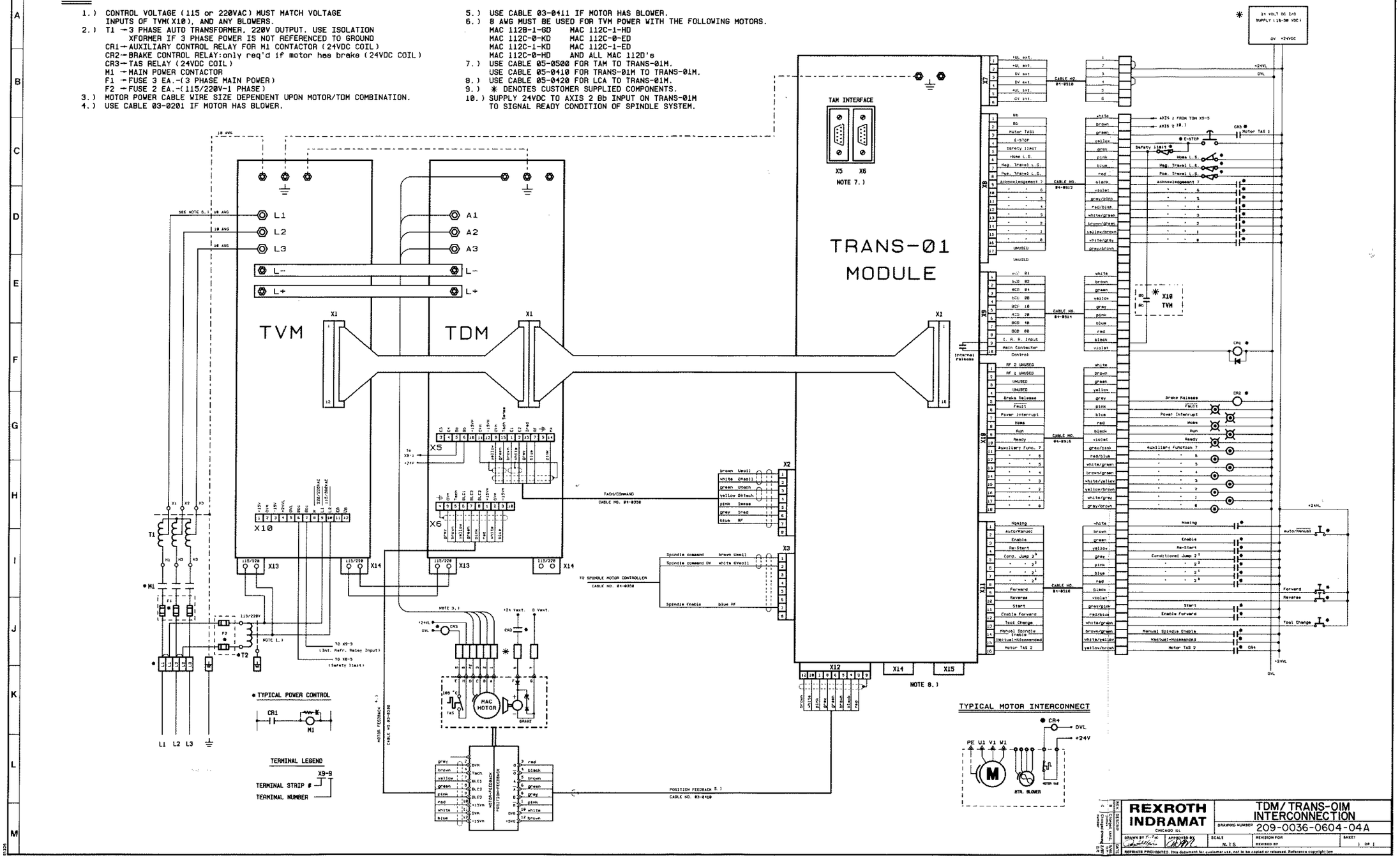


Figure 7-4. TRANS-01 M Interconnect Diagram -- System With TDM AC Servo Controller

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NOTES:

1.) CONTROL VOLTAGE (115 or 220VAC) MUST MATCH VOLTAGE INPUTS OF KDV (X10), AND ANY BLOWERS.
2.) T1 = 3 PHASE AUTO TRANSFORMER, 220V OUTPUT. USE ISOLATION XFORMER IF 3 PHASE POWER IS NOT REFERENCED TO GROUND
CR1 = AUXILIARY CONTROL RELAY FOR M1 CONTACTOR (24VDC COIL)
CR2 = BRAKE CONTROL RELAY:only req'd if motor has brake (24VDC COIL)
CR3 = TAS RELAY (24VDC COIL)
M1 = MAIN POWER CONTACTOR
F1 = FUSE 3 EA.-(3 PHASE MAIN POWER)
F2 = FUSE 2 EA.-(115/220V-1 PHASE)
3.) MOTOR POWER CABLE WIRE SIZE DEPENDENT UPON MOTOR/KDS COMBINATION.
4.) USE CABLE 03-0201 IF MOTOR HAS BLOWER.
5.) USE CABLE 03-0411 IF MOTOR HAS BLOWER.
6.) 8 AWG MUST BE USED FOR KDV POWER WITH FOLLOWING MOTORS.
MAC 112B-1-GD MAC 112C-1-HD
MAC 112C-0-KD MAC 112C-0-ED
MAC 112C-1-KD MAC 112C-1-ED
MAC 112C-0-HD AND ALL MAC 112D's
7.) USE CABLE 05-0500 FOR TAM TO TRANS-01M.
USE CABLE 05-0410 FOR TRANS-01M TO TRANS-01M.
8.) USE CABLE 05-0420 FOR LCA TO TRANS-01M.
9.) * DENOTES CUSTOMER SUPPLIED COMPONENTS.
10.) SUPPLY 24VDC TO AXIS 2 Bb INPUT ON TRANS-01M TO SIGNAL READY CONDITION OF SPINDLE SYSTEM.

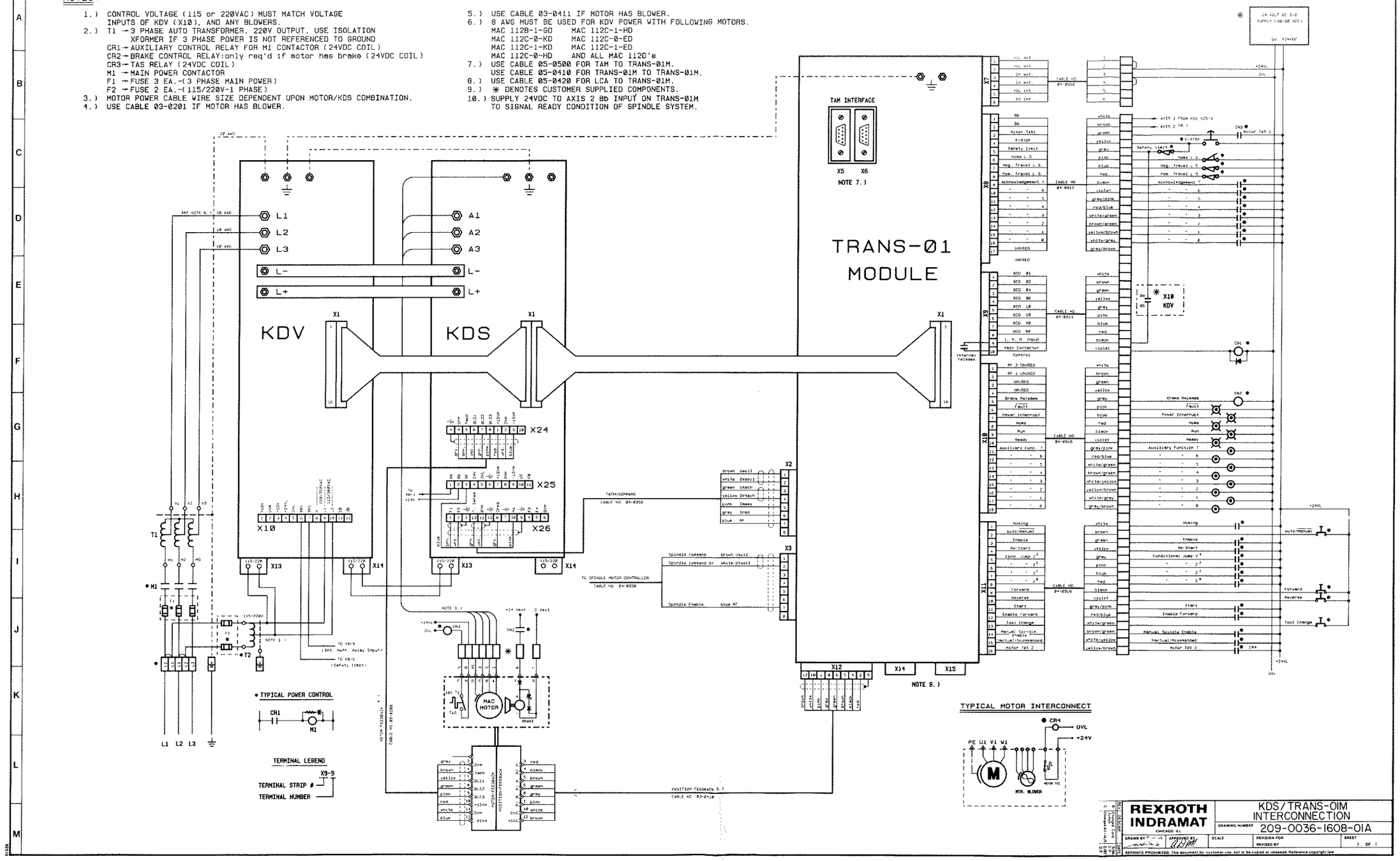


Figure 7-4A. TRANS-01 M Interconnect Diagram -- System With KDS AC Servo Controller

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CHAPTER 8. DIAGNOSTICS

8.1 GENERAL

The TRANS control continuously monitors all important functions of the system for correct operation. This includes all inputs, outputs, operating voltages, axis components, servomotor, tachometer, incremental encoder, limit switches, parameters and the user program. When operating faults or disturbances are detected, the control switches to the Diagnostic Mode (even if the disturbance is momentary), shuts the system down, and issues a diagnostic message in English on the TAM. This aids in quick determination and correction of faults.

The diagnostic status of the control can be interrogated at any time, even when no error is present, by selecting Diagnostic Display Mode. Thus, normal status indications, such as READY MISSING, can be observed; and causes of operation interruptions which do not appear as errors, such as the control waiting for an auxiliary function acknowledgment, can be determined.

In on-line operation, the fault can be detected by the Line Control via the data bus. The Line Control then switches to Diagnostic Mode and the diagnostic message appears in the display.

8.2 TYPES OF DIAGNOSTIC MESSAGES

There are four categories of diagnostic messages which may appear: Normal Status Diagnostics, Soft Faults, Hard Faults and Temporary Faults. The description of each diagnostic message in Section 8.3 specifies its category.

8.2.1 Normal Status Diagnostics

These are normal status displays, indicating current machine conditions. They include: DRIVE OPERATING, DWELL TIME, IMMEDIATE STOP, NO START, etc. They indicate the operation currently being performed or some operation ready or interrupted which will be performed as soon as the appropriate signal is received.

8.2.2 Temporary Fault

This type of fault is treated by the TRANS as a "Temporary Error." No other signals will be accepted by the TRANS as long as this condition persists, but no Reset of the control is needed once the problem is rectified. At that point, the TRANS will be in an immediate stop condition. Examples of Temporary Faults are: I/O SUPPLY MISSING, EMERGENCY STOP, etc.

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8.2.3 Soft Fault

A Soft Fault is an error which can generally be cleared by pressing the CE key and correcting the cause of the fault, such as re-keying data which was entered incorrectly.



For example, a key pressed in the incorrect sequence or an attempt to enter too many digits in a number results in the COMMAND ERROR or FORMAT ERROR diagnostic display and the lighting of the LED on the CE key. Correct the fault by pressing CE and re-keying the data.

8.2.4 Hard Fault

A Hard Fault is generally a hardware error of some kind, such as a failure of the encoder, a broken wire, etc. In this case, the position of the slide is no longer known. When a Hard Fault is detected, the following occur:

1. The TRANS drops the "Ready" (connector X10 pin 10) and "Run" (connector X10 pin 9) signals on the Cycle Interface and drops the "Fault" signal (connector X10 pin 6).

2. The appropriate diagnostic message appears in the display and the LED on the Reset key is lighted.

   You must remedy the fault, then press the Reset key. The TRANS comes up in Single Cycle Operating Mode and Diagnostic Display Mode. You must now home the axis before operations can continue.



8.2.5 External Fault Reset

Both Hard and Soft Faults can be reset by selecting Manual Mode on the Operator Interface (connector X11 pin 2 low) and actuating the "REVERSE" pushbutton (connector X11 pin 10). Press the pushbutton to clear the fault. Release it, then press again (and hold) to execute the Reverse program.

8.3 DIAGNOSTIC MESSAGES

This section provides a list of diagnostic messages (in alphabetical order) which may be displayed, with a description of the problem and suggested recovery procedures. If the recovery procedure is simply to check for the problem and correct it, follow the procedure as stated.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
(No Message)	When power is applied to the TRANS, but no message appears on the TAM display (or only one random digit is lit), there could be a processor error or a time-out error (processor running out of the executive program) caused by a severe noise spike. First recheck your TAM connections, then try turning power off, then back on. If the problem was a timeout error, it will be corrected. If not, replace the TRANS.
BUS ERROR	Hard Fault. Indicates that an error has occurred on the TRANS-BUS (connectors X14 and X15) when using the Line Control Adaptor (LCA). Possible causes are: defective cabling, a power interruption at the LCA or a defective LCA. Installing or removing TRANS-BUS cables under power can also cause this fault message.
COMMAND ERROR	Soft Fault. This error generally indicates the pressing of an incorrect key. Correct by pressing the CE key, then pressing the correct sequence of keys.
CONTROLLER OVERTEMP	Soft Fault. An overtemperature condition has been detected in the motor controller. This can be caused by an excessively high duty cycle, stalled motor, faulty controller cooling system, etc. Locate the cause and correct it, then press the CE key.
CORRECTION EXCEEDED	A soft fault indicating that an attempt was made to enter a correction value into one of the correction registers that is greater than the limit set in parameter P39 (MAXIMUM CORRECTION). This may occur while sending values automatically via a PEA on a TRANS-01 M. Press CE to clear the fault.
DRIVE FAULT	Hard fault occurring on TRANS-01s incorporating software previous to TR3x-005.0. Indicates that axis drive either moved when not commanded, or didn't move when commanded. See 'DRIVE RUNAWAY' and 'DRIVE STALLED' for possible causes.
DRIVE NOT READY	Temporary Error. Indicates that the "Ready" contact closure from the servo controller has not been received. This can be caused by: no main power to controller, no control voltage to controller or a defective controller. Refer to the diagnostic LED's on the servo controller and the appropriate user's manual to determine the exact cause. The occurrence of this condition is treated by the TRANS as a temporary error, meaning that while no other signals will be accepted by the TRANS as long as the condition persists, no reset of the TRANS is required after closure of the "Drive Ready" contact.

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DRIVE NOT READY (Cont'd)	On TRAN's incorporating rotary software, this diagnostic has an additional meaning. If a part program is written such that a movement is commanded during the time the Controller Enable signal is off (accomplished by turning on auxiliary function 7), this diagnostic will be displayed, and a hard fault will result.
DRIVE RUNAWAY	Hard fault diagnostic indicating axis drive has moved when not commanded to. Possible causes: Vertical slide with insufficient torque to hold unit, defective/disconnected encoder or cable, defective axis controller motor, or TRANS.
DRIVE STALLED	Hard fault indicating axis drive has not moved when commanded. Most likely causes: Jammed drive train, dull or broken tooling, blown servo controller main power fuses, or incorrect TRANS/servo controller/MAC Motor wiring. May also indicate a defective MAC motor or controller.
DRIVE OPERATING	Normal Status Diagnostic. In Automatic Mode, this indicates that the motor is moving during a cycle operation.
DWELL TIME	Normal Status Diagnostic. Indicates that the TRANS is presently executing a block containing a dwell time function. During this period, block display mode can be selected, and if the "F" line is displayed, the actual countdown of the dwell time may be observed.
EMERGENCY LIMIT	Hard Fault. Indicates that the Safety Limit (secondary overtravel) switch has been opened, dropping power to the servo controller. Check and correct the reason for the overtravel, then manually move the axis off the limit switch. Next, press Reset, then home the axis. The Safety Limit switch is wired between pin 7 and pin 5 on TRANS connector X8. If no Safety Limit switch is used, these three wires must be tied together.
EMERGENCY STOP	Temporary Error. The Emergency Stop circuit has opened, sensed by loss of voltage on pin 4 of connector X8. This signal is supplied by the machine builder and is often part of the Emergency Stop chain for the entire machine. The occurrence of this condition is treated by the TRANS as a temporary error, meaning that while no other signals will be accepted by the TRANS as long as the condition persists, no reset of the TRANS is required after the condition is remedied. If the Emergency Stop input is not used, pin 4 on connector X8 must be tied to +24 volts to prevent this error from occurring.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
ENCODER FAULT	Hard Fault. Indicates a problem in the encoder feedback. The TRANS constantly monitors the tachometer and encoder feedback signals, comparing them to each other and tot he velocity and presently commanded position. If the tachometer is indicating correct operation, but the encoder signals aren't, this message will be displayed. Causes may be a defective incremental encoder or position feedback cable. Correct the problem and press Reset. Under rare conditions, this diagnostic message may occur if the acceleration rates demanded by the system (determined by the Ramp and Max Feedrate parameters) cannot be met, caused either by unrealistic parameter values or excessive drive train inertia or friction. In this case, correct the drive train problems or reduce these two parameter values.
ENCODER FAULT - LAMP	Hard Fault. Indicates failure of the incandescent lamp used as a light source in the encoder. Replace the lamp, press Reset and home the axis.
ENCODER SUPPLY MISSING	Hard Fault. Indicates that the incremental encoder supply (internal to the TRANS) is low. This supply is used by the axis incremental encoder connected to X12 on the TRANS, and also any optional device that may be connected to X13. The cause could be faulty cabling on X12 or X13, a faulty incremental encoder or a faulty optional device. To isolate the problem area, initiate an emergency stop by removing voltage from pin 4 of connector X8. Remove the position feedback cable from the incremental encoder and press the Reset key. If the fault disappears, the problem is in the encoder. If the fault does not disappear, remove the position feedback cable from X12 on the bottom of the TRANS and press Reset again. If this diagnostic disappears, the position feedback cable is defective. If not, and an optional device is connected to X13 repeat the above procedure to determine if that device or its cable is at fault. If, with both connector X12 and X13 on the TRANS open, the diagnostic is still displayed after Reset is pressed, the TRANS is defective and should be replaced.
EXCESSIVE IDLE CURRENT	Soft Fault. Occurs in conjunction with optional Feed Adaption software (TR34). This message indicates that the amount of thrust measured at the beginning of the feed adaption block exceeds the value entered in the MAX-NO-THRUST-CURRENT parameter. Since this is a measure of current required before machining, it indicates an excessive amount of resistance in the drive train for the spindle (if spindle power is being monitored) or the slide (if axis power is being monitored). Correct the mechanical problem, press CE and retry the cycle.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
EXCESSIVE LAG	Hard fault indicating axis drive velocity did not keep up with commanded velocity, resulting in the following error, or lag, exceeding it's limits. Possible causes include: incorrect parameters, KV parameter too high for system inertia and/or friction, excessive friction torque in system. Remedy the fault and press RESET.
EXCESSIVE POS COMMAND	Soft Fault. The slide has been commanded to move to a position outside of the software travel limits during program execution. This could be caused by incorrect programming or excessive tool correction values. The sum of the position command and the tool correction value cannot exceed the +/- travel limit parameters.
EXCESSIVE THRUST	Either a Normal Status Diagnostic or a Soft Fault. This message occurs in conjunction with optional Feed Adaption software. If the thrust required in a cycle is ever great enough that feed reduction beyond the programmed "Feed Reduction" value occurs, this diagnostic will be displayed at the end of the cycle, possibly indicating dull tooling or excessively hard work-piece material. If the diagnostic is accompanied by illumination of the CE key, a Soft Fault has occurred because the TRANS reduced the feedrate by 99% and was still unable to reduce the thrust to the target value programmed in the Feed Adaption block.
FINISHING LAG	Normal status diagnostic indicating the TRANS has commanded the axis to stop, and is waiting during the decelerate phase (bringing position error, or lag, to zero). This will occur when a block is programmed with lag finishing (indicated by illuminated Lag Finishing key). Persistence of this diagnostic may indicate an obstruction very close to the final position, or excessively low KV parameter.
FORMAT ERROR	Soft Fault. An error has occurred while keying numeric information, such as entering too many significant digits or attempting to enter a decimal point when the value can have none. Press CE and re-enter the data.
FORWARD FINISHED	Normal Status Diagnostic. Indicates that the Forward input is activated in Manual Mode, but a Jump and Stop has been executed in the program. This diagnostic will not be displayed after a reverse vector of R000 (indicating end of the Forward program) is encountered. Instead, in that case, REVERSE - NO COMMAND will be displayed because the Forward input is ignored after a reverse vector of R000 is encountered.
FORWARD - IMMEDIATE STOP	Normal Status Diagnostic. Indicates an interruption of the forward cycle. This diagnostic will be displayed after reset of a soft fault which occurred during execution of the forward cycle, or if Cycle Stop is pressed during program execution.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
FORWARD - NO COMMAND	Normal Status Diagnostic. Indicates that the FORWARD pushbutton at the Operator Station was pressed in Manual Mode, but released before the forward cycle was completed.
FORWARD OPERATING	Normal Status Diagnostic. Indicates that the TRANS is executing the Forward program via activation of the Forward input (FORWARD pushbutton) in Manual Mode.
HOME SWITCH ERROR	Soft Fault. Indicates that the TRANS has detected an error in the actuation of the Home Limit switch. Once the first homing function is performed after a power-up or hard reset, the TRANS will remember where home position is. A subsequent move to home position, i.e., the execution of a homing command or a positioning command resulting in a move to home, causes a Home Limit switch check to be made. The TRANS first checks if the Home Limit switch has ever closed while the unit was farther than one motor revolution away from home. If so, the TRANS will stop immediately and display this diagnostic. If no false Home Limit switch actuations have been detected, the TRANS moves to home, checking that the Home Limit switch closes in the last motor revolution before the home position is reached. If it closes too early or does not close at all, this diagnostic is displayed. Possible causes are: loose switch or dog, interference causing switch actuation away from home, excessively noisy switch or excessive backlash in the drive train.
HOMING	Normal Status Diagnostic. Indicates that the TRANS is executing a block which was programmed with a homing function.
HOMING FINISHED	Normal Status Diagnostic. May occur in Automatic Mode, indicating homing is completed (jump and stop to block 000 executed) however the Homing input is still on.
HOMING MISSING	Soft Fault. Occurs when an attempt is made to select jogging rapid in Hand Mode before a homing operation is performed. Press CE, then home the axis before selecting jogging rapid.
IMMEDIATE STOP	Normal Status Diagnostic. Indicates that the cycle was interrupted, but is now ready for restart, both in Manual and Automatic Modes. This can occur after an emergency stop condition occurs, then is remedied; after an acknowledgment is lost, then corrected and CE is pressed; when the Immediate Stop key is pressed in Manual Mode; or after the I/O supply has been lost and then reapplied. If Immediate Stop occurs in Automatic Mode, recovery may be performed either by applying the Restart signal (to continue program execution) or by applying the Homing signal.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
I/O SUPPLY MISSING	Temporary Fault. Indicates that the 24 volt supply used for external signals is not present on connector X7, pins 1 and 3. This condition is treated as a temporary error, meaning that while no other signals will be accepted by the TRANS as long as the condition persists, no reset of the TRANS is required after restoration of the I/O supply. The TRANS will be in an immediate stop condition.
JOGGING - NO COMMAND	Normal Status Diagnostic. Indicates that Hand (jogging) Mode has been selected on the TAM keyboard but no actions are being commanded.
JOGGING OPERATION	Normal Status Diagnostic. Indicates that Hand (jogging) Mode has been selected on the TAM keyboard and one of the Jog keys is being pressed.
JUMP TO GAP	Soft Fault. Occurs during program execution, indicating that the current block commands a jump to a non-programmed block. Clear by pressing CE, then either correct the block jump or program the destination block.
LAG	Diagnostic message occurring in TRANS Executive Software previous to TR3x-005.0. If Reset key is also illuminated, a hard fault has occurred. Refer to 'EXCESSIVE LAG' diagnostic. In the absence of an illuminated Reset key, see 'FINISHING LAG' for description. 
LIN-ENCODER FAULT	Hard Fault. Can occur when using the optional Adaptive Depth Control package. During an adaptive depth control function, the TRANS constantly monitors the linear encoder, rotary encoder and tachometer signals. If the rate and/or direction of movement indicated by the tachometer and rotary encoder do not agree with the linear encoder, this fault will be displayed. The cause may be an incorrect parameter value for linear encoder resolution, loose drive train, or defective linear encoder or linear encoder cable. Press Reset and home the axis to recover.
LIN-ENC-PRE-LIMIT	Hard Fault. Can occur when using the optional Adaptive Depth Control package. It indicates that the linear encoder was deflected more than the limit specified in parameter P35 before an adaptive depth control program block was encountered. This is usually an indication of a mislocated part or an obstruction in the path of the linear encoder. Correct the problem, press Reset, then home the axis.
MEMORY LOST	Hard Fault. Indicates that TRANS working memory is unreadable, usually as a result of removing the battery for an extended period of time (or a defective battery). Replace the battery and press Reset. If HOMING MISSING is displayed, recover by homing the axis. If PROGRAM LOST or PARAMETER LOST is displayed you will need to re-enter the missing data.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
MEMORY LOST, (Cont'd)	Note that any tool correction values, current I/O status, slide position and reverse vector are all lost when this fault occurs. If the axis was in mid-cycle at the time this occurred, and a complex cycle with reverse vectors was being used, it may be necessary to recover (return to home) by hand due to possible interference problems.
MEMORY OVERFLOW	Soft Fault. Indicates that the TRANS has continued past block 127 without encountering a block jump. Press CE then correct the program.
MOTOR OVERTEMP	Soft fault. AN overtemperature condition has been detected in a servo axis servo motor, sensed by loss of 24 volts at connector X8, pin 3. This can be caused by an excessively high duty cycle, stalled motor, faulty controller, cooling system, etc. It may also indicate a defective servo motor or controller or incorrect wiring. Remedy the situation, then press CE. Note that when the TRANS senses that the overtemperature switch in the axis servo motor has opened, it will first finish the cycle, if one is in progress. The end of a cycle is detected by executing a Jump and Stop at block N000. After the cycle is complete, the TRANS will display the fault and open the Regulator Release (RF) for the servo controller (and spindle, if present). Cycle information (current position, Home, etc.) will not be lost.
N <> NCMD	Normal Status Diagnostic. Occurs in conjunction with TRANS executive software incorporating analog spindle output voltage capability. This diagnostic indicates that the spindle is not outputting the signal which indicates it is running at the commanded speed (or stopped, if so commanded). When speed changes are commanded by the TRANS, it halts program execution until the spindle responds with an indication that it has reached the new commanded speed (or stopped). IF the diagnostic persists, it may indicate a spindle overload condition, blown fuses, defective spindle controller or motor, defective cabling, etc.
NEW PARAMETER	Hard Fault. Issued as as warning that new parameters have been downloaded into the RAM memory from the Line Control Adaptor. To clear, insert the key into the Parameter keyswitch and turn it to the Parameter Entry/Edit position, then press the Reset key. This prevents unauthorized personnel from altering TRANS memory contents.
NEW PROGRAM	Hard Fault. Issued as a warning that a new program has been downloaded into RAM memory from the Line Control Adaptor. To clear, insert the key into the Program keyswitch and turn it to the Program Entry/Edit position, then press the Reset key. This prevents unauthorized personnel from altering memory contents.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
NO ACKNOWLEDGMENT ON X	Either a Normal Status Diagnostic or a Soft Fault. X is a specified auxiliary function. The Normal Status Diagnostic occurs during the time between the turning on or off of an auxiliary function and the receipt of its matching acknowledgment. For example, assume auxiliary function 2 is used to turn on the coolant pump, with the acknowledgment wired to a coolant pressure switch. NO ACKNOWLEDGMENT ON 2 would be displayed between the time the coolant pump is turned on and the time the pressure switch closes. A Soft Fault occurs if an acknowledgment was received, matching a function output (either on or off) and then is lost without a corresponding change in the function. To recover, remedy the problem, then press CE. The cycle then may be continued (use Restart if in Automatic Mode). Acknowledgments are expected on connector X8, pins: Pin 16, - Acknowledgment 0 Pin 15, - Acknowledgment 1 Pin 14, - Acknowledgment 2 Pin 13, - Acknowledgment 3 Pin 12, - Acknowledgment 4 Pin 11, - Acknowledgment 5 Pin 10, - Acknowledgment 6 Pin 9 , - Acknowledgment 7
NO ENABLE	Normal Status Diagnostic. Indicates that the Enable signal on the Cycle Interface (connector X11, pin 3) is missing. This signal must be provided by the customer's Line Control for automatic operations to occur. Enable is sometimes conditioned on the proper closure of protective gates at the machine. If Enable is expected, but not present, check for the cause of the fault and correct.
NO ENABLE - FORWARD	Normal Status Diagnostic. Indicates that 24 volts is not present at connector X11, pin 12 and the Forward program cannot be executed. This signal can be tied to Part Clamped and Spindle On Logic to prevent feeding into the part. Tool Change and Return (homing) programs may be performed without this signal present.
NO FEED ADAPTION WITH RAMP	Soft Fault. Can occur in conjunction with Feed Adaption option. Feed adaption may only be performed at feedrates less than the value programmed for Max Feedrate (Parameter P20). If attempted at higher rates, or programmed after a block containing a higher rate, this message will result. Press CE, correct the program and home the axis.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
NO FEEDRATE	Soft Fault. Indicates that this block contains a positioning command, but no feedrate (other than possibly rapid) was programmed in this or any previous block executed. Note that it is possible to program a positioning function without specifying a feedrate; however, a feedrate (other than rapid) must have been programmed in a previous block. In that case, the feedrate used will be the last feedrate programmed. This feature is required in some program schemes; however, it is good practice to program feedrates in each block whenever possible. Note that no memory is wasted by programming a feedrate. To recover from this fault, press CE and correct the program.
NO START	Normal Status Diagnostic. Indicates that the TRANS is ready to perform some operation and is only waiting for a Start signal. In Automatic Mode, this means that the TRANS is ready to execute the program beginning at block zero as soon as a Start signal is received on the Cycle Interface. In Single Block Mode, this message will appear each time the TRANS completes a block, and simply indicates that it is ready for another Start command via the CYCLE START key on the TAM keyboard. In Continuous Cycle Mode, it also indicates that the TRANS is waiting for the CYCLE START key to be pressed.
OPERATOR - HOMING MISSING	Normal Status Diagnostic. Indicates that Manual Mode is selected at the Operator Station, but the axis has not been homed since the last power upon reset. The only command which will be accepted is Return, to home the axis.
OPERATOR - NO COMMAND	Normal Status Diagnostic. Indicates that Manual Mode was selected at the Operator Station and the TRANS is waiting for a command. This diagnostic will be displayed when a Forward, Reverse or Toolchange cycle is completed.
OPT 0 POS DIST = +/-X.XXX(X)	Either a Normal Status Diagnostic or a Hard Fault. Indicates the "optimum zero position distance". Home position is determined by the first encoder marker pulse after the Home switch is closed. Limit switches have a finite time delay between actuation and closure (along with a certain inaccuracy), thus the Home Limit switch must be positioned so that it does not close too near the occurrence of a marker pulse. Doing so can result in sporadic home position errors of one motor revolution, depending on whether the switch closes just before or just after the marker pulse occurs.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
OPT 0 POS DIST = +/-X.XXX(X) (Cont'd.)	To prevent such a situation from occurring, the TRANS monitors the distance (in motor revolutions) between the closure of the Home switch and the occurrence of the marker pulse. If this distance is ever less that 90 degrees (1/4) motor revolution), the TRANS will shut the motor down, light the Reset key indicating a hard fault and display this diagnostic. The value displayed is the distance the actuation point of the Home Limit switch should be moved to have it close at the "optimum" point, which is 180 degrees away from the marker pulse. The units of measurement are the same as those chosen in the parameters (inch or mm). If the distance between the limit switch closure and the marker pulse is greater than 90 degrees, this message will still be displayed, as it is possible that the Home switch is on the "edge" and sporadic faults could occur. To determine the value at which this number will result in a a fault, determine what 1/4 motor revolution will be as: (Ballscrew Lead x Gear Box Rev Out)/(Gear Box Rev In x 4) All of the above values can be found in the parameters. It is recommended that the value displayed in this diagnostic never be more than 1/2 of the value calculated above. Note that it will probably be impossible to ever get the displayed value to consistently be zero, and it is not required, as the limit switch will not be repeatable enough.
PARAMETERS INVALID	Hard Fault. Indicates that the present TRANS parameters are not compatible with its executive software. This diagnostic will occur if executive software has been changed in a TRANS to a version with different parameter requirements. In this case, insert the Parameter key, turn the keyswitch to the Entry/Edit position, and press Reset. The old parameters will be erased and new ones must be programmed.
PARAMETER LOST	Hard Fault. Indicates that the parameter memory is unreadable, usually as a result of removing the battery for an extended period of time (or a defective battery). To recover, replace the battery, insert the Parameter key, turn it to the Parameter Entry/Edit position, then press Reset. Now re-enter the parameters manually or via the Line Control Adaptor.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
PARAMETER MODE	Normal Status Diagnostic, a Soft Fault or a Hard Fault. When Diagnostic Display Mode is selected in Parameter Mode, this diagnostic merely indicates that fact. If, however, an attempt is made to select a different mode (Hand, Single Block, etc.) while the Parameter keyswitch is in the Parameter Entry/Edit position, this diagnostic is displayed and the CE key is lighted to indicate a Soft Fault. If the Parameter keyswitch is turned to the Parameter Entry/Edit position while a program is being executed, this diagnostic is displayed and the Reset key is lighted to indicate a Hard Fault. In addition to previous operation, this condition will also be diagnosed as a hard fault if the spindle was enabled (spindle regulator release, RF, on) at the time the parameter key was switched, regardless of whether a cycle was being executed or not. This is done to insure that an unpredictable restart of the spindle will not occur when the parameter key is removed.
PART LOCATION ERROR	Soft Fault. Can occur when using the optional Adaptive Depth Control package. It indicates that the linear encoder was not deflected by the time the TRANS encountered a block using Adaptive Depth Control. The linear encoder must make contact with the part before the block programmed for Adaptive Depth is executed. To recover, press CE. This fault sometimes occurs in systems that have been operating properly, but have had feedrates increased. The reason is that the TRANS begins executing a block before the motor has reached the position commanded in the previous block (unless With Lag Finishing is selected). As speed is increased, the lag distance increases. If the lag distance becomes too large, the linear encoder may not yet be deflected when the TRANS begins executing the Adaptive Depth block. The solution is to increase the distance traveled in the block previous to the Adaptive Depth block.
POSITION ERROR	Hard Fault. Indicates an error in the encoder circuit, the encoder or its wiring. When the TRANS traverses out from the home marker (zero) pulse, it maintains a count of the distance traveled in terms of encoder pulses. It expects to encounter exactly that same number of pulses on its return to the zero point. This error occurs anytime there is more than a +/-3 pulse discrepancy in position. For example,this error will occur if the TRANS is homed from a position 10,000 pulses from the marker pulse, but travels 10,004 pulses on its return.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
POSITIVE STOP MISSING	Soft Fault. Indicates that the current block, which contains a move-to-positive-stop function, has been executed,but the axis traveled the full programmed distance without encountering a stop. Press CE, home the slide and correct either the program or the mechanical fault.
POWER INTERRUPT	Normal Status Diagnostic. When power is dropped during a cycle, the TRANS records that fact and issues the POWER INTERRUPT diagnostic when power returns. It also places a high signal on the Power Interrupt line on the Cycle Interface (connector X10, pin 7). The last known position of the slide is stored when power drops. The position will be accurate within 0.080 inch (2 mm) because of motor drift. It is up to the system designer to determine the recovery action when the fault occurs. However, the axis must be homed before a program can be executed. Note that this interrupt occurs only if power drops during a cycle -- not at rest or while jogging. If power drops during jogging, the system comes up in a reset mode, and will allow normal jog only. The axis must then be homed before a program can be executed. Refer to Section 6.13 for more information on power interrupt operation and recovery.
PROGRAM INVALID	Hard Fault. Indicates that the present TRANS program is not compatible with its executive software. This diagnostic occurs if executive software is changed in a TRANS to a version with different program requirements. In this case, insert the Program key, turn the keyswitch to the Entry/Edit position, and press Reset. The old program will be erased and a new one must be entered.
PROGRAM LOST	Hard Fault. Indicates that the program memory is unreadable, usually as a result of removing the battery for an extended period of time (or a defective battery). To recover, replace the battery, insert the Program key, turn it to the Program Entry/Edit position, then press Reset. Now re-enter the program manually or via the Line Control Adaptor.
PROGRAMMING MODE	Normal Status Diagnostic, a Soft Fault or a Hard Fault. When Diagnostic Display Mode is selected in Programming Mode, this diagnostic merely indicates that fact. If, however, an attempt is made to select a different mode (Hand, Single Block, etc.) while the Program keyswitch is in the Program Entry/Edit position, this diagnostic is displayed and the CE key is lighted to indicate a Soft Fault.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
PROGRAMMING MODE (Cont'd)	If the Program keyswitch is turned to the Program Entry/Edit position while a program is being executed, this diagnostic is displayed and the Reset key is lighted to indicate a Hard Fault. In addition to previous operation, this condition will also be diagnosed as a hard fault if the spindle was enabled (spindle regulator release, RF, on) at the time the parameter key was switched, regardless of whether a cycle was being executed or not. This is done to insure that an unpredictable restart of the spindle will not occur when the parameter key is removed.
RANGE ERROR	Soft Fault. Indicates that the number (e.g., parameter value) entered is outside the range limitations of the TRANS. For example, this would occur if the ballscrew lead entered is greater that 3.0000 inches (30.000 mm).
READY MISSING	Normal Status Diagnostic or Soft Fault. Occurs in Automatic Mode indicating that not all of the conditions have been met to accept a Start signal. When this diagnostic occurs, the Ready output on the Cycle Interface (used to indicate that the TRANS is ready for operation) goes low to indicate Not Ready. The conditions required for the TRANS to be in a Ready state include: 1. Automatic Mode selected. 2. Block N000 selected. 3. Axis normalized (homing performed since last power-up by reset). Normally, a READY MISSING condition may be rectified by performing a homing operation. READY MISSING can also occur as a Soft Fault, in which case it will be accompanied by the illumination of the CE key. Such a condition results when the CYCLE START key on the TAM is pressed, but the axis has not been homed since the last power up or reset. This will occur in Continuous Cycle, Single Cycle, or Single Block modes. To recover, press CE and home the slide.
RETURN ILLEGAL	Soft Fault. Indicates that during program execution the TRANS has encountered a block with a RETURN from a subroutine in it, but is not presently executing a subroutine. This can occur if the jump to subroutine is not programmed, or if the main program is allowed to "run into" a programmed subroutine. Press CE to clear the error, then correct the program.
REVERSE FINISHED	Normal Status Diagnostic. Indicates that the Reverse input is activated but the TRANS has completed execution of the Reverse program.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
REVERSE - IMMEDIATE STOP	Normal Status Diagnostic. Indicates an interruption in the reverse cycle. For example, this diagnostic will be displayed after reset of a Soft Fault which occurred during execution of the reverse cycle or if CYCLE STOP is pressed during program execution.
REVERSE - NO COMMAND	Normal Status Diagnostic. Indicates: 1) that the REVERSE pushbutton at the Operator Station has been pressed in Manual Mode, but released before the Reverse program was completed; or 2) that a reverse vector of R000 was encountered during manual execution of the Forward program, signaling the end of that program. This diagnostic message will also be displayed if the TRANS is switched from Automatic to Manual Mode during Reverse program execution.
REVERSE OPERATING	Normal Status Diagnostic. Indicates that the Reverse input is actuated in Manual Mode and the program is being executed. Note: if the block being executed contains a homing instruction, HOMING will be displayed instead of REVERSE OPERATING.
SCANNING INTERRUPTED	Soft Fault. Indicates that scanning between the Line Control Adaptor (LCA) and the TRANS was interrupted for more than 500 msec during a cycle initiated by the LCA over the serial bus. This is a safety measure to insure that if a TRANS is being controlled via the LCA that communications between the LCA and the TRANS will be present at all times.
SERVO VOLTAGE ERROR	Hard Fault. Indicates that one of the servo controller voltages (+24 or +/-15) is either missing or not within limits. This could be the result of a defective NC cable, an excessively long NC cable, an NC cable that is routed in a very noisy environment, a defective servo controller, or a defective motor feedback package. The area can be isolated by referring to the diagnostic LEDs on the servo controller (refer to the appropriate user's manual). After the fault has been located and corrected, press Reset to clear the error. Then home the axis.
SPINDLE NOT IN POSITION	Normal status diagnostic that may occur during a spindle positioning command, the TRANS has completed commanding the spindle to position, but the position has not yet been reached. Persistence of this diagnostic can indicate an excessive amount of resistance in the spindle drive train (i.e., high friction or blocked drive train), too low a spindle KV value (parameter P37), or an incorrect spindle sensitivity (parameter P38).

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
SPINDLE NOT READY	Temporary Fault. Occurs in conjunction with TRANS Executive Software incorporating analog spindle output capability. Indicates that the TRANS has not received the "Ready" contact closure from the spindle drive, sensed by the absence of 24 VDC on connector X8, pin 2. Possible causes may be: no control voltage or main power at the spindle controller, blown fuses, etc. Refer to the trouble shooting section of the appropriate spindle controller user's manual to determine the exact cause. The occurrence of this condition is treated by the TRANS as a temporary fault, meaning that while no other signals will be accepted by the TRANS-01 as long as the condition persists, no reset of the TRANS is required after restoration.
SPINDLE OVERTEMP	Soft Fault. An overtemperature condition has been detected in the spindle motor, sensed by loss of 24 volts at connector X11, pin 16. This can be caused by an excessively high duty cycle, stalled motor, faulty controller cooling system, etc. It may also indicate a defective spindle motor or controller or incorrect wiring. Remedy the situation, then press CE. Note that when the TRANS senses that the overtemperature switch in the spindle motor has opened, it will first finish the cycle, if one is in progress. The end of a cycle is detected by executing a Jump and Stop at block N000. After the cycle is complete, the TRANS will display the fault and open the Regulator Release (RF) for the spindle and servo controllers. Cycle information (current position, Home, etc.) will not be lost.
SPINDLE RUNAWAY	A hard fault indicating spindle has moved without command. Possible causes: Parameter 42, bit 0 incorrect; Spindle encoder cable or encoder disconnected or defective; spindle controller defective; spindle motor defective.
SPINDLE STALLED	A hard fault indicating the Spindle is not moving at the commanded rate. Most likely causes: blocked spindle, bad tooling, jammed spindle gear box, excessively high or low spindle KV (P37), or incorrect parameter P38 (SPINDLE RPM/10 VOLTS). Can also be a defective motor or controller.
TACHO FAULT	Hard Fault. Indicates a problem in the tachometer feedback. The TRANS constantly monitors the tachometer and encoder feedback signals, comparing them to each other and to the commanded velocity and position. If the encoder is indicating correct operation, but the tachometer is not, this message will be displayed. Causes may be a defective tachometer, motor feedback cable or NC cable. Correct the problem and press Reset.

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
TACHO FAULT (Cont'd)	Under rare conditions, this diagnostic message may occur if the acceleration rates demanded by the system (determined by the Ramp and Max Feedrate parameters) cannot be met, caused either by unrealistic parameter values or excessive drive train inertia or friction. In this case, correct the drive train problems or reduce these two parameter values.
THRUST MISSING	Normal Status Diagnostic. Can occur when using the optional Feed Adaption Software (TR34). This diagnostic will be displayed at the end of a cycle (after a jump to block 000 and stop) that contained an adaptive feed block and indicates that the thrust never exceeded the minimum thrust value programmed in the MIN-THR-CURRENT line of the adaptive feed block. This is simply a warning, possibly indicating a broken tool or missing workpiece.
TOOL CHANGE FINISHED	Normal Status Diagnostic. Indicates that the Tool Change input is activated, but the TRANS has completed the tool change program.
TOOL CHANGE-IMMEDIATE STOP	Normal Status Diagnostic. Indicates an interruption in the tool change cycle. For example, this diagnostic will be displayed after reset of a Soft Fault which occurred during execution of the tool change cycle or if CYCLE STOP is pressed during program execution.
TOOL CHANGE-NO COMMAND	Normal Status Diagnostic. Indicates that execution of the tool change program was initiated by activating the Tool Change input in Manual Mode, but the input signal was dropped before completion of the program.
TOOL CHANGE OPERATING	Normal Status Diagnostic. Indicates that the Tool Change input is activated in Manual Mode and the TRANS is executing the tool change program.
TOOL CORRECTION	Normal Status Diagnostic. Indicates the Tool Correction Entry/Edit Mode is selected.
TRAVEL LIMIT (+/-)	Soft Fault. Indicates that one of the overtravel limits has been reached. This can be either a software overtravel or one of the physical overtravel limit switches. You must press CE, then move or jog the axis off the switch or software limit. Positive overtravel limit switch - connector X8, pin 9 Negative overtravel limit switch - connector X8, pin 10

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MESSAGE	DESCRIPTION/SUGGESTED RECOVERY
UNACCEPTABLE PARAMETERS	Soft Fault. Each time the Parameter keyswitch is returned to its normal position, the TRANS calculates necessary data based on the existing parameters. If the calculated values fall outside the operating system limits, this diagnostic will appear. To determine which parameter is creating the problem, turn the Parameter keyswitch back to the Entry/Edit Mode and press the Clear Error (CE) key. The first parameter causing a problem will now be displayed. See Section 4.6 for a more detailed description of parameter error checking and recovery procedures, plus complete tables of parameter limits and parameter calculation formulas.
WAITING FOR CONTROL XX	Normal status diagnostic. This will occur if the TAM programming panel has not been assigned to communicate a specific TRANS-01 M.
WRITE PROTECTED	Soft Fault. Indicates that an attempt has been made to enter or change system parameters or the program without using the Program or Parameter keyswitch to enable Program or Parameter Entry/Edit Mode. The diagnostic display occurs when the Dialog or Edit keys are pressed.
WRONG LIN-ENC-DIRECTION	Hard Fault. Indicates that the linear encoder was deflected opposite from the expected direction. This could be caused by an obstruction near the linear encoder, a loose workpiece, or the linear encoder direction parameter (P33) set to a "0" instead of a "1". Remedy the problem, press Reset, then home the slide.
ZERO PULSE MISSING	Hard Fault. Indicates that during a homing function, the encoder turned one full revolution without the TRANS detecting a zero (marker) pulse. Because the TRANS uses the ENCODER CYCLES/REV parameter to determine what one motor revolution is, many times this message means that the wrong value was entered in that parameter, such as 625 instead of 1250. If the parameter is correct, either the incremental encoder or its cable is faulty. Replace the defective component, press Reset, then home the axis.

8.4 INTERACTION OF DRIVE FAULT, TACH FAULT AND ENCODER FAULT

When the system issues a command voltage for drive motion, it expects to see a tachometer voltage feedback (within a voltage window) of the opposite polarity. If there is no tachometer voltage or it is the wrong polarity (and encoder pulses are present) TACHO FAULT is diagnosed.

If the tach is correct, but there are no encoder pulses or they are the wrong polarity, ENCODER FAULT or LIN-ENCODER FAULT is diagnosed as appropriate.

If neither tachometer nor encoder feedback is present after the command voltage is issued, DRIVE FAULT is diagnosed. Note that DRIVE FAULT is also diagnosed if no command has been issued but tachometer and encoder feedback are present.

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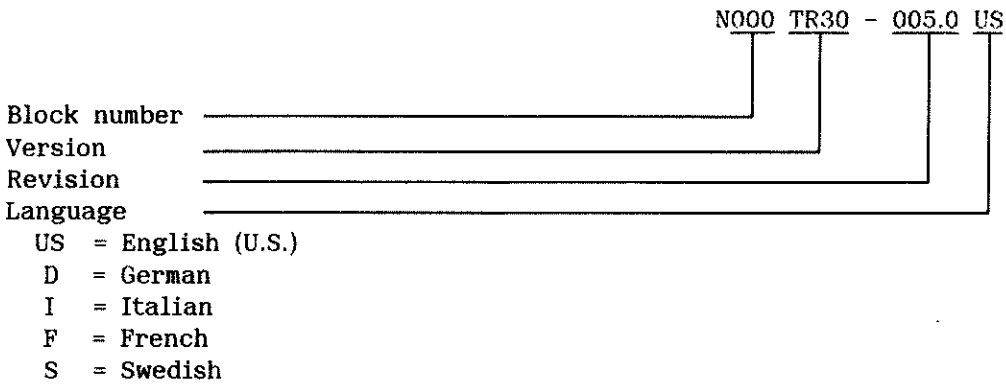
CHAPTER 9. TRANS-01 M OPTIONS

9.1 INSTALLING SOFTWARE OPTIONS

This chapter contains descriptions of various TRANS options, including:

* Adaptive Depth Control
* External Tool Correction Input
* Rotary Motion Control
* Feed Adaption Option
* Feed Ramp Option
* Modified Auxiliary Output Functions

When one of these options is provided, modified executive software for the TRANS is also provided. Appendix B lists the versions of executive software presently available and the options supported by each. Refer to the label on the front of your TRANS cabinet to determine the software version installed, or select manual mode (on the Operator interface) and press the Reverse Vector Jump key to see the software version number in the TAM display, as:



If you expand your system to add options, you will need to install new executive software. The executive program of the TRANS is fixed and is supplied by INDRAMAT. This program is contained on an EPROM (Erasable Programmable Read-Only Memory), mounted on the CPP-2 card of the TRANS, as illustrated in Figure 9-1 on page 9-2.

Install a new executive software EPROM as follows:

1. Turn power OFF! If you insert or remove an EPROM while the TRANS is powered you will destroy the program and probably ruin the EPROM.

2. If necessary, remove the TRANS from its mounting cabinet,then loosen the screws on the right side panel and remove the panel. You will see the PRP.2 printed circuit board containing one 27256 EPROM mounted in the upper left hand corner of the CPP-2 printed circuit board as illustrated in Figure 9-1.

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3. Remove the EPROM which contains your original software.

4. Install the new 27256 EPROM. Make sure the notch on the EPROM matches the notch on the socket.

5. Replace the right side panel, and re-install the TRANS in its enclosure.

6. Make sure you correct the "Software Version" label on the TRANS. (Usually not supplied.)

7. You can now power up the TRANS and load parameters and a program.

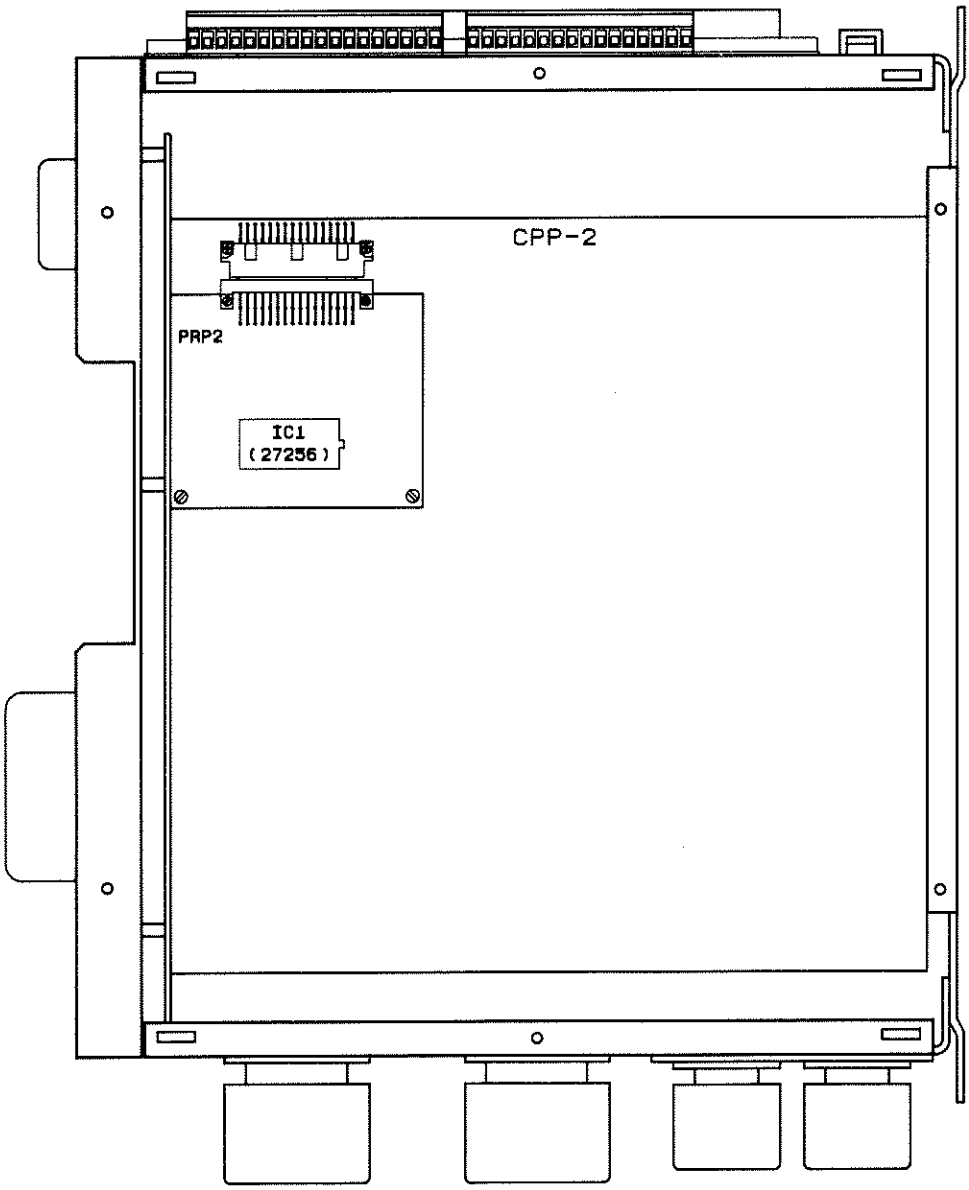


Figure 9-1. Executive EPROM Location In TRANS

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9.2 ADAPTIVE DEPTH CONTROL

As provided by optional software TR35, the TRANS has the capability of positioning the slide directly from a linear encoder instead of using the feedback from the motor's encoder. With this function, it is possible to compensate for both drive train variations and workpiece position variations. By using incremental positioning, it is possible to program distances relative to the face of the workpiece.

9.2.1 Associated Parameters

A variety of linear encoders can be used in TRANS systems with adaptive depth control. The parameters described below are used to adapt the system to work with a particular encoder.

Para-meter	Description	Format Inch	Format Metric
P25	MAX FEEDRATE FOR G5. Sets the maximum feedrate that can be programmed for the TRANS while operating with the linear encoder. If a higher feedrate is encountered in a block programmed using a linear encoder, a soft fault will occur and the RANGE ERROR diagnostic will be displayed.	XXXX.X	XXXXX
P32	LIN-ENC-RESOLUTION. Specifies the linear distance traveled per linear encoder line. Note that the encoder provides four pulses per line. Thus, an encoder with 2.5 micro-meters per pulse is entered in this parameter as 10 micrometers per line.	X.XXXXX	XX.XXXX
P33	LIN-ENCODER-DIRECTION. Coordinates the linear encoder deflection with slide direction. A "0" indicates that positive motion (as programmed into the TRANS) will cause increased deflection of the linear encoder. A "1" indicates that negative motion cause increased deflection of the linear encoder.	X	X
P34	MAX LIN-ENC-DEFL. This parameter specifies the maximum possible deflection of the linear encoder. This value is determined by the full-stroke limit of the linear encoder used, less any pre-deflection present in the mechanical linkage. Enter in inches or mm. A RANGE ERROR diagnostic will occur if an attempt is made to program an adaptive depth program block with a "LIN DESTINATION" value higher than the value specified in this parameter.	XXX.XXXX	XXXX.XXX

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Parameter	Description	Format Inch	Format Metric
P35	LIN-ENCODER PRE-LIMIT. Sets the maximum amount of deflection the linear encoder may have while the motor's encoder is active (normal positioning). The value of P33 will determine if P35 is positive (P33=0) or negative (P33=1). This parameter can be used to indicate part mislocation.	XXX.XXXX	XXXX.XXX

9.2.2 Installing The Adaptive Depth Control Option

Install the Adaptive Depth Control Option as follows:

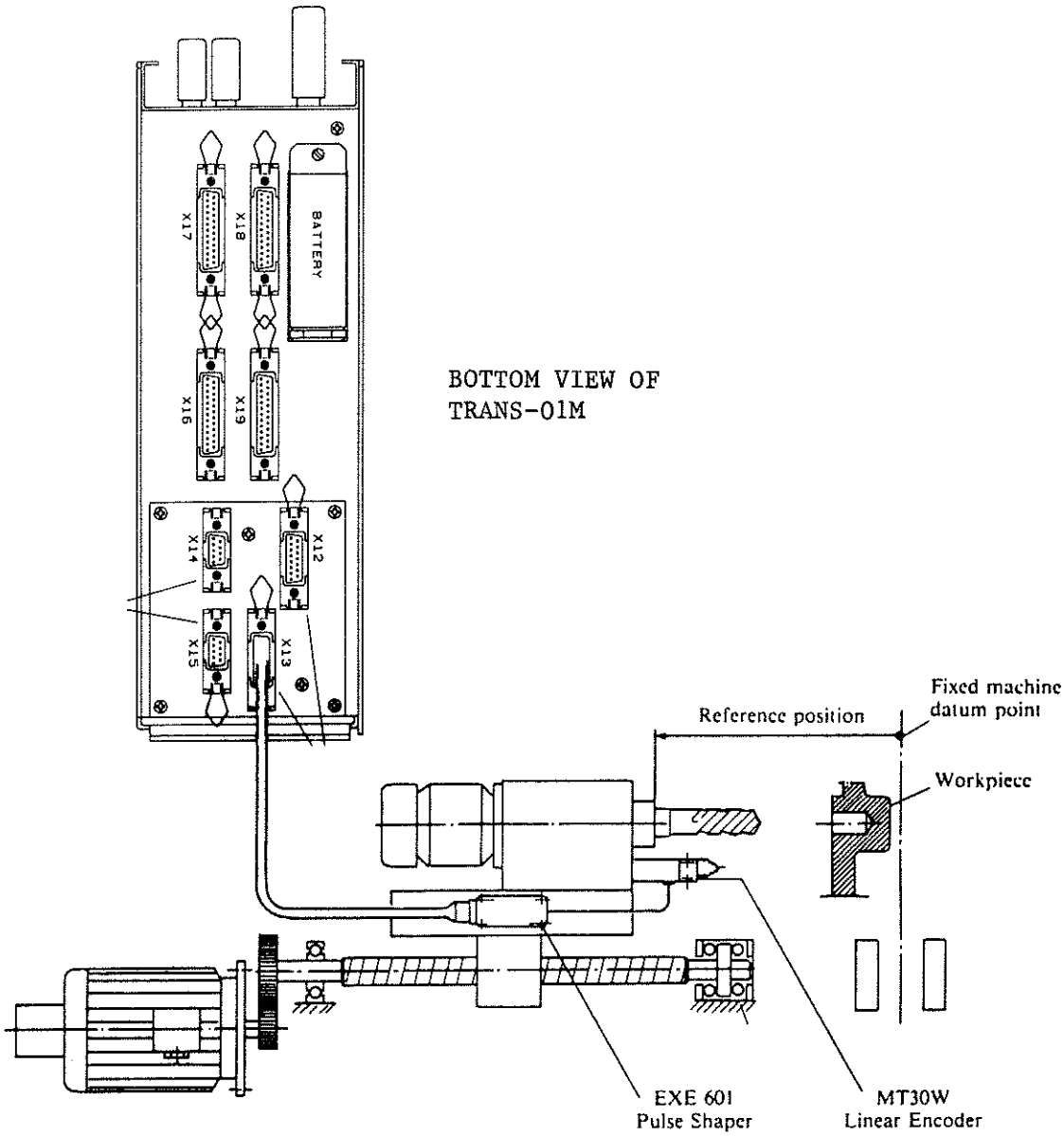
1. Install the TRANS system using the guidelines described in Chapter 7.

2. Mount the linear encoder in the selected position and mount the pulse-forming module as close as possible to the encoder. Figure 9-2 (on page 9-5) illustrates the TRANS-Adaptive Depth Control interconnection. Figure 9-3 is a dimensional drawing of the EXE 601 Pulse Shaper.

3. Route the orange cable from the EXE 601 Pulse Shaper to the TRANS, connector X13.

4. Install the new optional executive software PROM as described in Section 9.1.

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Note: Use this drawing in addition to drawing 209-030-2701/4A.

Figure 9-2. Adaptive Depth Control Interconnection

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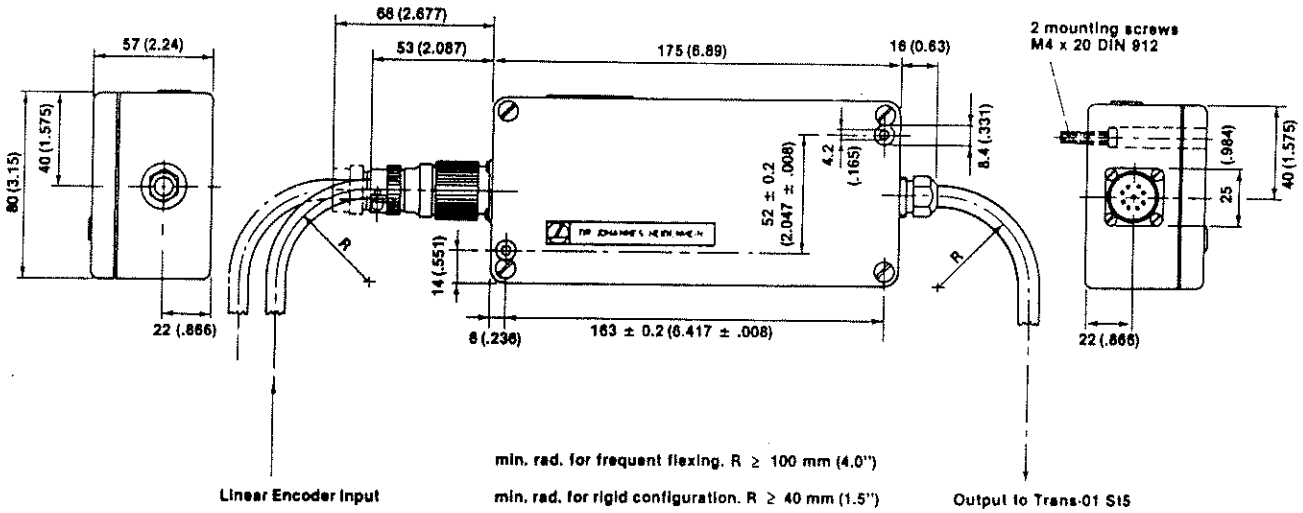
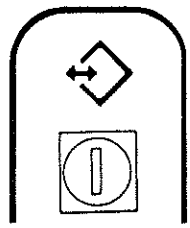


Figure 9-3. EXE 601 Pulse Shaper Dimensional Drawing

9.2.3 Programming The Adaptive Depth Control Function



1. Switch the system to Manual Mode at the Operator Station.
2. Establish communication between your TAM and the TRANS as described in Section 3.4.
3. Insert the correct key into the Program keyswitch and turn it to select Program Entry/Edit Mode.
4. Press  (Block No. Select)
5. Type the number of the first block you wish to program (leading zeros need not be entered), then press ENTER.

NOTE

At any time, if you make an error while entering data, press DEL (Delete) to delete the last data entered, then re-key the data and press ENTER.

You can use the N and LF (Line Feed) keys to successively increment the displayed block number.

6. Press  and FUNCTION? will appear in the display.

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NOTE

To guard against accidental program changes, DIALOG must be pressed to program each block. After pressing DIALOG, you can exit Programming Mode without changing the block by pressing the Reset key.

7. Select adaptive depth programming by pressing the  key. LIN DESTINATION? will appear on the display.

8. Key in the total linear deflection desired, then press ENTER. The linear encoder must already be deflected before this function is used, so when this block is executed the slide will move the distance programmed, minus the "pre-deflection" described below. See Section 9.2.4 for details on linear encoder deflection requirements.

9. The TRANS automatically selects absolute positioning and lag finishing for blocks using the linear encoder for adaptive depth control. Thus, after each positioning command is executed, the motor will come into position and stop before the next block is executed.

   TOOL CORRECTION? now appears in the display. From this point, you will program the TRANS following the standard programming procedure, starting as described in Section 5.5.3.2, step 11. You can select Tool Correction and various Miscellaneous Functions.

   Note that FEEDRATE? was not displayed, because the TRANS will use the last feedrate programmed. IF the last programmed feedrate exceeds the value set in parameter P25, a soft fault will occur and the RANGE ERROR diagnostic will be displayed.

9.2.4 Linear Encoder Deflection

The TRANS will move the slide as required to cause the linear encoder to be deflected the amount programmed for "Lin-Destination." Because the TRANS closes a position loop using the linear encoder (meaning that the encoder must reflect the movement when the motor is turned), the linear encoder must be in contact with the part when the adaptive depth block is reached. The instant the linear encoder encounters the part surface, the TRANS will begin counting the distance the encoder is deflected. Thus, the normal movement of the slide, plus the movement commanded in the adaptive depth block, will make the total deflection equal to the value entered as "Lin-Destination."

Example:

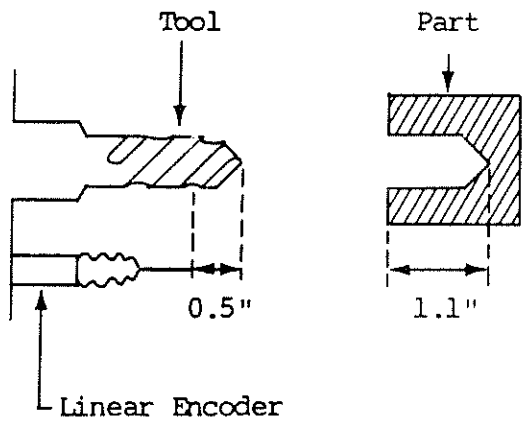


Figure 9-4. Example of Linear Encoder Deflection

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To cut a 1.1 inch hole in a part, given a slide with the tip of the linear encoder 0.5 inches behind the tip of the tool, a 0.6 inch deflection is required and is entered as the Lin-Destination value.

The complete program contains a rapid advance, a normal feed greater than 0.5 inches (to get the linear encoder deflected) and an adaptive depth block of 0.6 inches. If the first part run causes the encoder to be deflected 0.15 inches during the normal feed, the TRANS will move the slide 0.45 inches under adaptive depth control to equal 0.6 inches total linear deflection.

9.2.5 Typical Program Structure

The simplest part program using adaptive depth control consists of five program blocks. They are:

Block 000 — Specifies a rapid movement that will bring the slide to a point close to the workpiece, without any deflection on the linear encoder.

Block 001 — Programmed with a normal feed (using the motor's encoder for position feedback) to a point where the linear encoder is deflected, but not greater than the value specified by parameter P35, "Lin-Encoder Pre-Limit." The linear encoder must be deflected, because the next block will close the position loop around the linear encoder.

In the example program of Figure 9-6, note that block 001 is programmed selecting "Without Lag Finishing," which results in a smooth transition between the normal feed block and the linear encoder block (no stopping the motor).

Block 002 — This block contains a movement using the linear encoder. The distance programmed in this block will be the total amount of linear encoder deflection, including the deflection that occurred in the previous block. This block is automatically programmed using absolute positioning and lag finishing to ensure that the programmed distance is reached before the next command is executed.

If the workpiece has not been contacted by the time this block is reached, the TRANS will shut down and issue the diagnostic message, PART LOCATION ERROR.

Block 003 — Specifies a dwell time plus a reverse vector of R000, which indicates the end of the forward profile.

Block 004 — A return of the slide is programmed, followed by a Jump to Block 000 and Stop.

The actual movement of the slide is illustrated in the profile shown in Figure 9-5. Figure 9-6 is a programming worksheet for the program just described.

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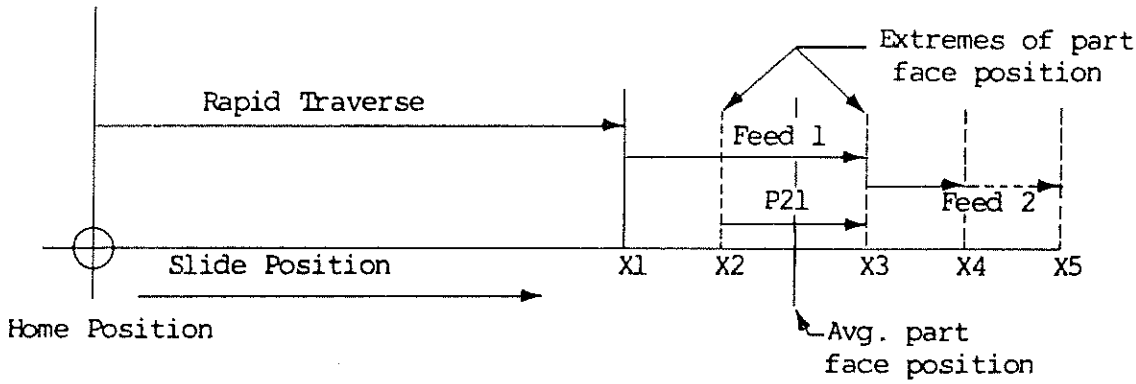


Figure 9-5. Profile of Operation Using Adaptive Depth Control

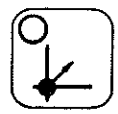
In determining program values, it is best to make a chart similar to the above. Determine the values as follows:

1. Calculate the average distance between the face of the part and the tip of the linear encoder with the slide at the home position.

2. Determine the maximum amount of deviation in the part position, illustrated as the distance between X2 and X3 in Figure 9-5, again referenced to the tip of the linear encoder at the home position.

3. The slide position at the end of the rapid traverse (position X1 in Figure 9-5) should bring the encoder tip just short of the extreme 'back' position of the part face (X2). In other words, the rapid traverse must be completed short of the closest point the part could be positioned to home.

4. The first portion of the feed (at normal feedrate) is selected by pressing the absolute positioning key (shown at right). It should end with the tip of the encoder at the extreme forward position of the part face (position X3). If the part is missing or too far forward, the PART LOCATION ERROR diagnostic will be issued at the end of this first feed.



5. Now the value of parameter P35, "Lin-Encoder Pre-Limit" can be determined. Referring to Figure 9-5 again, it is X3 minus X2, the distance between the part face position extremes.

   During the first feed of this operation, if the part face is located closer to home than position X2, the TRANS will issue the LIN-ENC PRE-LIMIT diagnostic when the amount of encoder deflection exceeds the value in Parameter P35.

6. Next select the value for the second feed (in block 002) using the linear encoder (selected by ).

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This is equal to the desired depth of the hole, plus or minus the distance between the tip of the encoder and the tip of the tool. This will result in a final position somewhere between X4 and X5, depending on the part location.

Note that the software travel limit (parameter P10 or P11) should be greater that the sum of the distance between home and the point X5, plus the maximum amount of tool correction that may be used.

9.2.6 Illustration

Figure 9-7 is a flowchart of the programming procedure using adaptive depth control.

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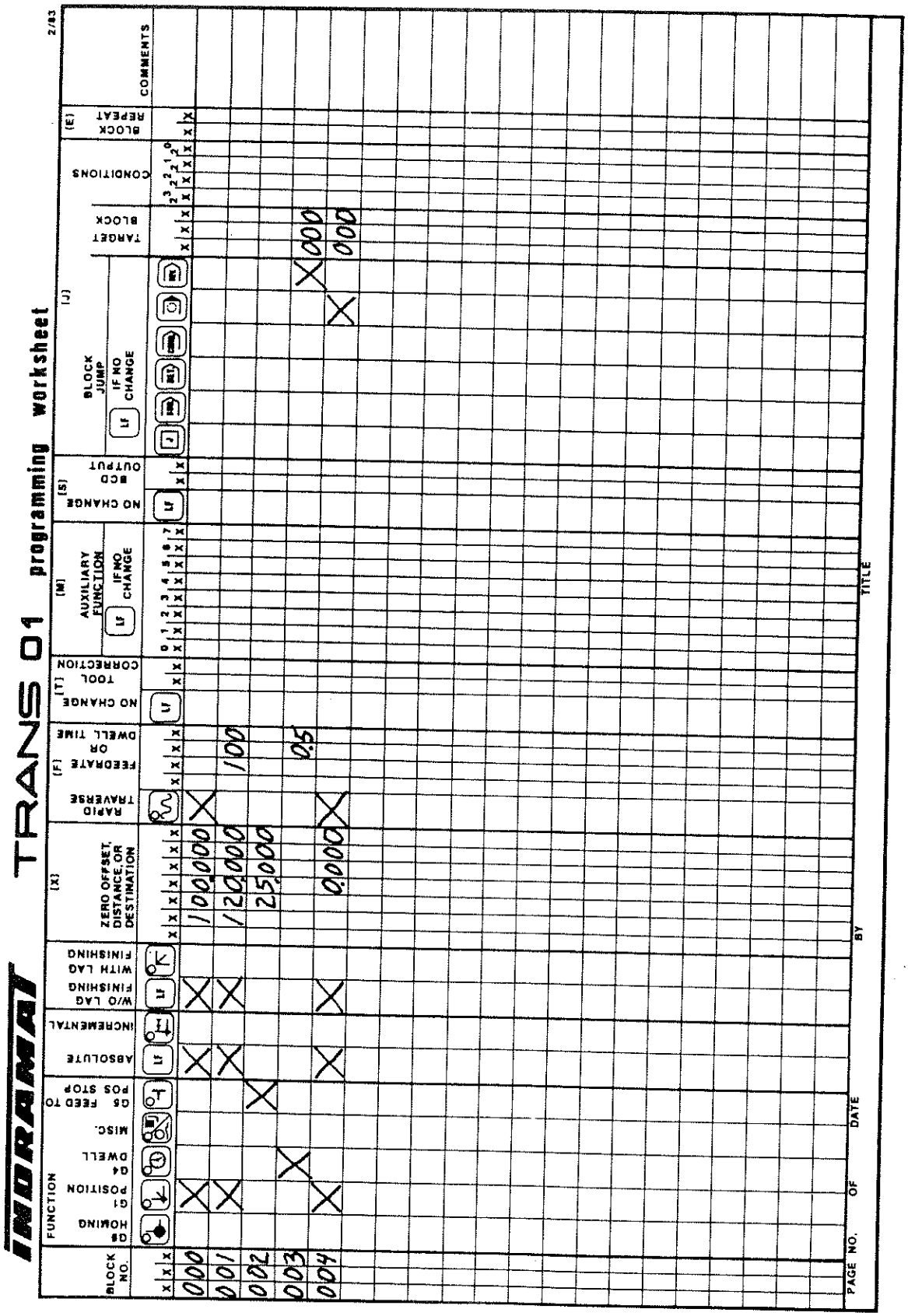


Figure 9-6. Programming Worksheet -- Typical Adaptive Depth Cycle

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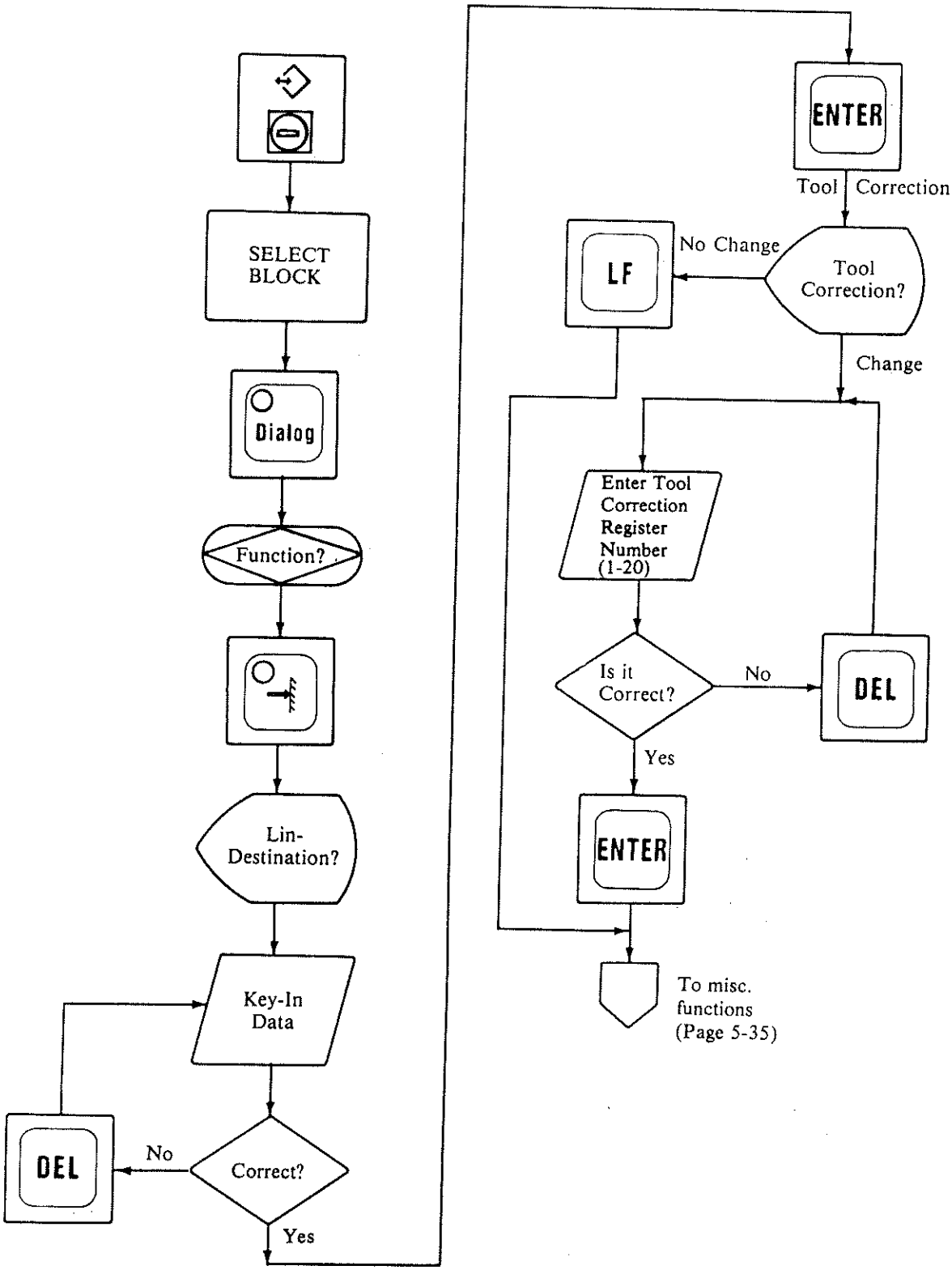


Figure 9-7. Adaptive Depth Control Programming Flowchart

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*** THE FOLLOWING INFORMATION (SECTION 9.3) IS PRELIMINARY ***
CONTACT INDRAMAT ENGINEERING IF YOU HAVE ANY QUESTIONS.

9.3 OPTIONS - EXTERNAL CORRECTION, TRANS-01 M

With an optional Parallel Input/Output Module (PEA), position correction values can be entered into the MODULAR TRANS's Correction Registers directly from outside devices. Both Correction Register T01 and T02 may be addressed, and values can either replace the current contents of the particular register (absolute) or be summed with the current contents of the particular register (absolute) or be summed with the current contents (incremental). Absolute or Incremental operation is parameter selectable. Values between -0.9999 to +0.9999 inches (-9.999 to +9.999 mm) may be transmitted.

Two operations are possible, transmission of a new value to a given Register, or resetting to zero (Clearing) of a register. Each operation occurs in a 'handshaking' manner, meaning a command is sent to the TRANS-01 M via an input signal, after which the TRANS-01 M will initiate a sequence of commands, waiting for an acknowledgment after each command before proceeding to the next. The following sections describe the TRANS-01M software and hardware requirements, the signals associated with the PEA, and a description of the transmission procedures.

9.3.1 Software Requirements

The Executive Software installed in the MODULAR TRANS must be revision TR3x-005.0 or later.

9.3.2 Hardware Requirements

All MODULAR TRANS Hardware versions may be used with the External Correction option, however a PEA (Parallel Input/Output card) must be installed in position III on the VNK1 card (bottom of the MODULAR TRANS), and the associated cable connected between the PEA card and the bottom of the MODULAR TRANS.

9.3.3 Parameters

To select External Correction, set bit 3 in OPERATION MODE 2 (parameter P41) to '1'. The PEA card must be installed when this is done, otherwise 'UNACCEPTABLE PARAMETER' will be displayed when the parameter key is removed.

OPERATION MODE 2 (parameter P41), bit 4 is also used in conjunction with External Correction Input, selecting whether input values should be treated as absolute or incremental. Absolute means that when a new value is transmitted, it will replace the current contents in the register, whereas incremental values will be summed with the current contents.

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9.3.4 External Correction Interface Signals

The following signals are provided to interface the TRANS-01 M with the device transmitting correction values to the TRANS-01M. All signals are located on connector X17, a 25 pin sub-D connector on the bottom side of the MODULAR TRANS-01.

The basic specifications for all signals are as follows:

INPUTS

Input Resistance:	~ 8 Kilo-Ohm
Input Current at 4 VDC Input Voltage	3 Milliamps
Input Voltage:	24 VDC ± 30%
On (high) voltage range:	16.8 VDC - 31.2 VDC
OFF (low) voltage range:	-15 VDC - +8 VDC

(All voltages with respect to OVI/O on connector X17)

OUTPUTS

Output Voltage, On (High):	26VDC ± 20% (20 - 32 VDC)
Output Current, On (High):	50 Milliamps maximum
Output Voltage, Off (Low):	4.5VDC (no load)
Output Resistance, Off (Low):	22 Kilo-Ohms

(All outputs are short-circuit proof)

CONNECTOR SPECIFICATIONS

Type	25 Pin Sub-D
On TRANS-01M:	ITT Cannon Type DB SF-25S
Mating (Cable) Connector:	ITT Cannon Type DB-25 P
Standard Indramat Cable:	209-0036-4859-00

9.3.4.1 OVI/O

Connector - TRANS-01M X17
Pins - 1, 2, 3, 4, 5, 6, 7, 8, 9

These pins are tied to the common of the internal 24 V supply of the TRANS-01M (sourced from the connected modular power supply, KDV or TDM), and may be used as a reference for all input and output signals on connector X17.

9.3.4.2 Register Select

Connector - TRANS-01M X17
- 21 - Register T01
- 20 - Register T02

Type - Inputs to TRANS-01M

These inputs select which Correction Register is to be written to or cleared. Only one input should be brought high at a time, however if both are high, the one that was detected as high first will be the Register selected by the TRANS-01M. If both are brought high at the exact same time, Register T01 has precedence.

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When the TRANS sees one of the Register Select lines go high, it will examine the Clear Register input. If that input is high, it will perform a Register Clear operation, otherwise it will assume a value is to be transmitted to the TRANS.

9.3.4.3 Data Lines

Connector - TRANS-01M X17
Pins - 17 - Data Line 8
- 16 - Data Line 4
- 15 - Data Line 2
- 14 - Data Line 1
Type - Inputs to TRANS-01M

Correction values are transmitted to the TRANS-01M by placing each digit, as requested by the TRANS-01M, in BCD fashion on these four lines. For example, a '5' is represented by bringing Data Lines 1 and 4 high, keeping 1 and 8 low.

When the Sign (plus or minus) bit is transmitted to the TRANS, Data Line 1 is used. A '+' sign is indicated by Data Line 1 being low, a '-' by setting it high.

9.3.4.4 Clear Register

Connector - TRANS-01M X17
Pin - 18
Type - Input to TRANS-01M

To clear a Register (reset it's value to zero), this input is brought high, then the appropriate Register Select line is brought high. This signal MUST be high and stable before selecting Register T01 or T02, otherwise the TRANS-01M will interpret the command as a value transmission.

9.3.4.5 Data Valid

Connector - TRANS-01M X17
Pin - 19
Type - Input to TRANS-01M

Data Valid is used during the transmission procedure as a handshake acknowledgment after each portion of the sequence is completed. Data being sent should be placed on the Data Lines allowed to stabilize, then the Data Valid line brought high. The Data Valid signal should remain high for at least 60 milliseconds to be recognized by the TRANS-01M.

9.3.4.6 Digit Request Lines

Connector - TRANS-01M X17
Pins - 22 - Sign (Plus or Minus)
- 10 - Digit 1 (Most significant digit)
- 23 - Digit 2
- 11 - Digit 3
- 24 - Digit 4 (Least significant digit)
Type - Output from TRANS-01M

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These outputs are used to indicate which digit is currently being requested by the TRANS-01M. Their actual weight depends on the System of Units used, as indicated by the 'X' below:

Digit	Inch Mode	Metric Mode
1	0.X000	X.000
2	0.0X00	0.X00
3	0.00X0	0.0X0
4	0.00X	0.00X

9.3.4.7 Complete

Connector - TRANS-01M X17
Pins - 25 - T01 Error
- 13 - T02 Error

If an error occurs during transmission of a value, the Error output associated with the Register being worked with will go high for 100 milliseconds. The error diagnostic 'CORRECTION EXCEEDED' will also appear on the TAM display (if connected), and a soft fault will result.

9.3.5 Transmission Procedure

A typical transmission sequence is as follows:

a. Select Register to be written to by bringing 'Register T01' or 'Register T02' high. This input must remain high throughout the entire sequence, otherwise an error will result, with the current Register contents remaining unchanged.

b. The TRANS-01M will respond by bringing the 'Sign' output high. The sign (+ or -) of the value is indicated by setting Data Line 1 high for a minus value, low for a plus. Set the data bit accordingly, keeping Data Lines 2, 4 and 8 low. When the 4 Data Lines are stable, bring Data Valid high.

c. After the TRANS-01M sees Data Valid go high, it will read the Sign data, then bring the Sign output low. At this point, the Data Valid line must also be brought low, as an acknowledgment to the TRANS.

d. Once Data Valid is low, the TRANS will bring the 'Digit 1' output high, indicating it is ready to read the most significant digit of the value. Place that digit's value, in BCD form, on the 4 Data Lines. When the Data Lines are stable, bring Data Valid high.

e. After Data Valid is high, the TRANS will read Digit 1's value from the data lines, then bring the 'Digit 1' output low. Acknowledge by bringing Data Valid low.

f. The procedure ins steps d and e is repeated for Digit 2, Digit 3 and Digit 4.

g. Once Data Valid is brought low after the TRANS has read Digit 4, the TRANS will indicate a successful transmission by bringing the 'Complete' output high. Complete will remain on until the Register Line (Register T01 or Register T02) is brought low. In any case, 'Complete' will remain high at least 100 milliseconds.

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After the transmission sequence is complete, the display on the TAM (if one is connected) will show the Correction Register and it's new value regardless of the current display mode. This will remain on the display until the Register Select line is brought low, and in any case, for at least 100 msec.

If, at anytime, an error is detected during transmission, such as the Register select line going low before the sequence is completed or an attempt was made to exceed the maximum allowable correction (Parameter P39), the appropriate Error output will go high for 100 msec. A soft fault will also result at the TRANS-01M, and the message 'CORRECTION EXCEEDED' will be displayed on the TAM (if connected).

9.3.6 Clearing a Correction Register

The sequence to clear a Register (set it's value to zero) is:

a. Bring the Clear input high.
b. Bring the desired Register Select (T01) or T02) high.
c. After the clear function is performed, the TRANS will respond by bringing 'Complete' high, at which time the Register select line may be brought low.

9.3.7 Programming Hints

It is recommended that a time-out be incorporated into the program in the transmitting unit to avoid a lock-up condition if a signal fails to occur (for example if a wire breaks). This timer would start when one of the Register Select lines or Data Valid is brought high, and be reset by a rising edge on any of the eight PEA outputs (Sign, Digit 1, etc.).

9.4 ROTARY MOTION CONTROL

The optional TR33 software configures the TRANS to control the motion of a rotary, rather than a linear, application. This option is used for applications such as rotary tables or lift and transfer drives. Rotary positions can be programmed in any type of units convenient to the application. Rotary speeds are also entered in these same units.

Provisions have been made to allow operation with an external brake, disabling the motor under program control. This feature is intended for those applications where the sizing of the AC Servomotor is based on the load requirements when positioning, and where the loads seen by the motor during machining may be greater.

The TRANS may be purchased complete with version TR33 software, or the software may be installed in an existing TRANS.

9.4.1 Associated Parameters

Since the system of units for rotary motions is arbitrary, the UNITS parameter has been eliminated. No travel limits exist, so both +TRAVEL LIMIT & -TRAVEL LIMIT are also eliminated, as well as BALLSCREW LEAD. When reviewing parameters, these 4 are simply skipped over by the TRANS. One additional parameter, UNITS/TABLE REV, is included with rotary software. This parameter, number P07 is described in Section 4.5.

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Para-meter	Description	Format Inch	Format Metric
P07	UNITS/TABLE REV -- This parameter functions the same as with standard software (see 4.5), however the value is expressed in Units/Table Rev, limited to the value set for the UNITS/TABLE REV parameter.	XXX.XXXX	XXXX.XXX
P19	RAMP -- The ramp is expressed in units/table rev/sec/sec. For example, if 360 is chosen for units/table rev, the ramp is programmed in degrees/sec/sec.	XXX.X	XXXX
---	SPEEDS -- Homing Speed, Rapid Speed, Jogging Speed, Jogging Rapid, Max Feedrate, and Max Feedrate For G5 are all expressed in units/table rev/min.	See parameter description in Chapter 4.	

9.4.2 Installing the TRANS Rotary System

Installation of the TRANS and AC Servo drive is carried out as normal (see Chapter 7). The reducer ratio between the AC servomotor and the output of the drive train may be any whole value number, because it is parameter adaptable. The Home Limit switch components must be designed so that the limit switch will remain closed from the time the switch is first actuated until the unit decelerates and reverses direction.

9.4.3 Programming Rotary Motions

Rotary software uses conventional TRANS programming techniques as described in Chapter 5. Only certain motions and/or working units change.

9.4.3.1 Homing and Zero Offset (NC code G0)

When Homing is selected during dialog programming, the TRANS will display ZERO OFFSET?. The value entered as the zero offset will determine the value of the home position on the absolute grid of the table. For example, if degrees are used as the units (360 units/table rev), and 10 is programmed as the zero offset, home position will be called "10 degrees". If an absolute move to zero degrees is commanded after that, the table would move 10 degrees. Note that no additional motion will occur with the inclusion of a zero offset; it is simply a value to be used for home position once it is reached. If a value other than zero is programmed in the parameter for reference position, this value will only show positive values, -25 + 10, or -15 degrees. Since the display will only show positive values, this would appear as 360-15, or 345 degrees.

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9.4.3.2 Positioning (NC code G1)

Positioning of the rotary table can be performed as either absolute positioning (a point referenced to home position) or incremental positioning (referenced to present position). If absolute positioning is selected, the table will move to the programmed DESTINATION using the shortest possible path (less than one-half table revolution). The destination may be any value between 0 and the number set in the parameters as UNITS/TABLE REV. No negative values are allowed.

Incremental positioning will cause the table to move the specified DISTANCE from the present position. Direction may be specified by programming the distance as a positive or negative value. The value of the distance is limited to plus or minus the value for UNITS/TABLE REV. If more than one table revolution must be made, block repeats (E-line) can be used, in which case up to 100 table revolutions may be performed in one block.

9.4.3.3 Clamping

If the drive train is configured so that the system will be clamped when in position, for example to prevent overloading of the AC Servo (resulting in undesired movement) during machining, the servo controller must be disabled during that time. If it is not, the system may attempt to hold a position, or even move the drive train, causing servo overload. Auxiliary function M07 has been dedicated in the rotary software to accommodate this need. This auxiliary function should be used for no other purpose than clamping or braking the drive train. If M07 is turned on during program execution, the AC Servo's Controller Enable will be removed, allowing free movement of the servomotor (no servo lock). At the same time, auxiliary function output M07 will turn on, and can be used to energize the clamp or brake. The Controller Enable will be restored when M07 is turned off. During the time that M07 is on, no movements should be commanded, otherwise "DRIVE NOT READY" will appear on the display, resulting in a hard fault. Only dwell times, block jumps or waits for acknowledgments should be performed while M07 is on.

While M07 is on, the destination will be made equal to the actual position, so that no jump will occur if the motor is rotated, then M07 is turned off. This means that the next positioning command made after a clamping operation should be an absolute move. Incremental moves would be made referenced to last commanded position. If incremental moves are required after a move to positive stop, they should be preceded by an absolute move to the last position, to correct for any shift in position during clamping.

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The last move made before a clamping operation should be programmed with lag finishing, so that the motor is stopped in position before the Controller Enable is removed. If the block is programmed without lag finishing, the commanded position may not be reached before power to the motor is dropped.

An example of programming clamping is shown in Figure 9-11. Assume that the drive system is operating a rotary table, and 360 has been entered for units/table rev. Block N000 moves the table to the 90 degree position, and turns on auxiliary function 7. This causes the Controller Enable to the AC servo to be dropped, and is also used to energize the clamp. The TRANS halts program execution and waits for auxiliary function 7 to be acknowledged. When it is time to move the table once again, the controlling device (e.g., programmable controller) will give acknowledgment 7 to the TRANS, allowing it to continue program execution. Block N001 turns off auxiliary function 7, which turns off the clamp and restores the Controller Enable to the AC servo. Program execution is then halted at block N002 by the jump-and-stop in N001. The subsequent blocks perform similar moves, resulting in 4 positions per table revolution.

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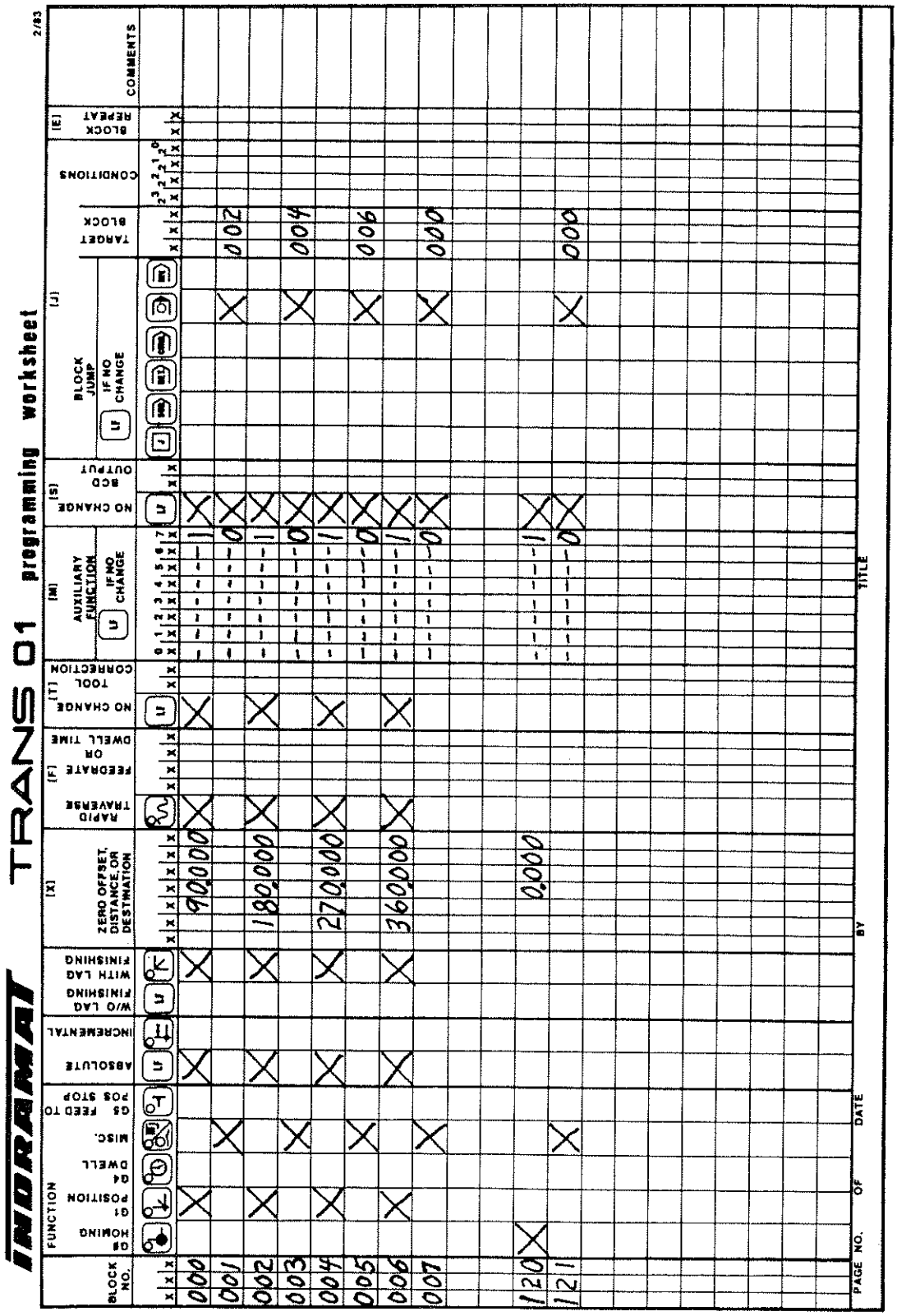


Figure 9-10. Programming Worksheet -- Example Using Rotary Motion Control Software

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9.5 FEED ADAPTION OPTION

With optional TR34 software, the TRANS can be configured to automatically alter the feedrate of an axis drive to maintain constant loading. It will also indicate, via outputs available on control connector X10, whether the maximum allowable thrust current for the application has been exceeded (indicating worn or broken tools for example), or whether the cycle required too little thrust current (e.g., missing part or broken tool).

On a TRANS containing feed adaption software, all normal functions are available except the feed-to-positive-stop function.

9.5.1 Associated Parameters

Two additional parameters are included in software incorporating the adaptive feed function. They are: P30, NOM CURRENT (A), and P31, MAX NO THR-CURRENT. These parameters are described in Section 4.5.

9.5.2 Programming Adaptive Feeds

The programming of adaptive feeds is performed within a block containing the positioning function (G1) -- the same block containing the move where thrust will be developed. Since the TRANS dynamically controls the feedrate in a feed adaption process, the feedrate programmed in such a block will be used as the upper limit in the adaption process. Note that block repeats may not be programmed in a block containing an adaptive feed. For details on programming positioning moves, refer to Section 5.5.3.2.

9.5.2.1 Idle Detection

After tool correction is entered (or bypassed) the question "IDLE DETECTION?" appears on the TAM display. Pressing ENTER will cause the TRANS to measure the idle current present at the beginning of the block's execution, and store this value. This value will be subtracted from all future thrust current measurements to determine the actual machining thrust current measurements to determine the actual machining thrust current required. With idle detection enabled, maximum no thrust current will also be checked, as described in Section 9.5.1. Idle thrust current detection may be programmed in the same block as the adaptive feed, or possibly in an earlier block (e.g., after the spindle is energized).

Pressing LF in response to the question "IDLE DETECTION?" will disable the function. Feed adaption may still be performed; however, to determine actual cutting thrust, the TRANS will subtract the last known idle value from the measured thrust current (or will subtract zero if no idle detection has been performed since the last power-up or reset).

A "D" in the block summary (see Section 5.5.2) indicates that idle current detection has been programmed in the displayed block.

9.5.2.2 Feed Adaption

After "IDLE DETECTION?", the question "FEED ADAPTION?" will appear in the display. Pressing LF will skip over feed adaption function, and a number of dialog questions will occur. Note that the letter "A" will appear at this time in the summary of block contents (Section 5.5.2) indicating feed adaption is present in this block.

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If feed adaption is chosen, "MIN THR-CURRENT?" (minimum thrust current) will appear on the display. The value entered here (from 1 to 99) will represent the minimum thrust current that should be present during the feed process. Note that the value entered is a percentage of the current rating entered in parameter P30, NOM CURRENT.

If the complete block is executed without the thrust current exceeding this value, the Thrust Missing output will be turned on immediately, and the THRUST MISSING diagnostic will occur at the end of the cycle (after a Jump to Block 000 And Stop). This is only a warning, possibly indicating a broken tool or missing part, so no fault occurs. Minimum thrust-current will be displayed as "IMI=xx" (where "xx" is the percentage entered above) when reviewing or editing the block.

"FEED REDUCTION" now appears in the TAM display. The value entered here may be from 1 to 99, and represents the maximum feedrate reduction that may occur (in percent) before the Excessive Thrust output is turned on. The output will turn on immediately if this percentage factor is exceeded, and the EXCESSIVE THRUST diagnostic will be displayed at the end of the cycle (Jump to Block 000 And Stop). Feed reduction will be displayed as "FR=xx" during block review or editing. For example, if a Feed Reduction of 25 is entered, the Excessive Thrust output is turned on if the machining feedrate is reduced to 75% of the programmed feedrate.

After feed reduction is entered, the dialog process will continue with normal miscellaneous functions (see Section 5.5.3.5).

9.5.3 Associated Signals

Two additional signals are available on the TRANS with the feed adaption option. All signals are 24 VDC, operated from the customer supplied I/O power supply used for normal TRANS interface signals, described in Chapter 6.

9.5.3.1 Thrust Missing

Connector - TRANS X10
Pin - 4
Status - Normally open
Type - Output from TRANS

Thrust Missing will be turned on at the end of a block containing the feed adaption function if the actual thrust current never exceeded the minimum thrust current value programmed in the block. Thrust Missing may indicate broken tooling or a missing part. The output is reset at the beginning of each cycle.

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9.5.3.2 Excessive Thrust

Connector - TRANS X10
Pin - 3
Status - Normally open
Type - Output from TRANS

The TRANS will turn this output on whenever the feed reduction required to maintain desired thrust current exceeds the programmed feed reduction value. It will be turned off upon receipt of the next Cycle Start command in Automatic Mode, or the next Forward command in Manual Mode. If this output is accompanied by the Fault output, feedrate was reduced by 99% without reducing thrust current to the desired value. In either case, the output may indicate excessively hard part material or dull or broken tooling.

9.5.4 Diagnostics

With the diagnostic display mode selected, a special message is displayed during a feed adaption process to provide information concerning feed and load performance. The format is:

Nxxx IO=aa/bb TH=cc/dd/ee %ff/gg

Where:

aa = actual idle thrust current factor
bb = maximum idle thrust current programmed in the parameter
cc = actual (present) load factor
dd = commanded (desired) load factor
ee = minimum thrust current factor programmed in the block
ff = actual feed reduction in %
gg = feed reduction trigger level (excessive thrust trip point) in %

Additional diagnostic messages are:

DIAGNOSTIC MESSAGE	MEANING
EXCESSIVE IDLE CURRENT	Soft Fault. Occurs when the idle current exceeds that value entered in the MAX NO-THR-CUR parameter.
THRUST MISSING	Normal Status Diagnostic. Occurs when the thrust current during a cycle never exceeded the MIN THR-CURRENT value programmed in the block. This is not diagnosed as a fault, rather as a warning indicating possible broken tooling or a missing part.
EXCESSIVE THRUST	Either a Normal Status Diagnostic or a Soft Fault. If the thrust current required in a cycle is ever great enough that feed reduction beyond the programmed "FEED REDUCTION" value is necessary, this diagnostic will occur at the end of a cycle, possibly indicating dull tooling or excessively hard part material. If the diagnostic is accompanied by illumination of the CE key, a Soft Fault has occurred indicating that 99% feed reduction occurred without reduction of thrust current.

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9.6 FEED RAMP OPTION

9.6.1 General Description

TRANS executive software version TR32 provides a feed ramp capability (plus modified auxiliary outputs - discussed in Section 9.7).

The standard TRANS software controls system acceleration as follows:

1. Below the maximum feedrate specified in parameter P20, acceleration is limited only by the system gain (parameter P14). This is true because maximum acceleration/deceleration is usually desired for speed changes in the cutting speed range. Controlled ramping of acceleration in the cutting speed range is not available in the standard TRANS software, but is provided by the Feed Ramp option.

2. Above the maximum feedrate, acceleration in standard software is limited to the value specified in the Ramp parameter (P19). This limit is necessary to avoid excessive mechanical stresses on the drive train caused by accels/decels to and from rapid traverse speeds.

The optional Feed Ramp capability allows ramping acceleration in any speed range, but is usually used for a smooth transfer from one speed to another within the cutting speed range, to avoid "instantaneous" jumps in speed as the feedrate changes from one block to another.

In order to obtain a smooth acceleration/deceleration from speed V1 to speed V2 (from one block to the next), the following conditions must be met:

1. The direction of motion selected in both blocks must be the same.

2. The first block must not be programmed with lag finishing.

3. Feed Ramp must be programmed into the second block.

4. No conditional jumps are allowed in the first block.

The Feed Ramp can be useful in other situations, such as:

1. The system has a very high position loop gain for high accuracy, but accelerations in the feed range would be excessive if limited only by that gain.

2. It is desired to accelerate at normal rates; to decelerate using a ramp, such as in a speed reversal using a gearbox which has considerable play.

9.6.2 Installing the Option

Installation of TR32 executive software is done per the procedures described in Section 9.1.

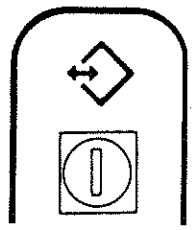
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9.6.3 Parameter

Parameter P36 is used only in TR32 software for Feed Ramp.

Parameter	Description	Format Inch	Format Metric
P36	FEED RAMP -- When selected in Dialog programming for a block, the value programmed in this parameter specifies the system acceleration limit for that block in all feed and rapid speed ranges. Enter in inches/sec/sec or mm/sec/sec. minimum value -- 0.1 inch/sec/sec 1 mm/sec/sec maximum value -- 999.9 inch/sec/sec 9999 mm/sec/sec	XXX.X	XXXX

9.6.4 Programming the Feed Ramp



1. Switch the system to Manual Mode at the Operator Station.
2. Establish communication between your TAM and the TRANS as described in Section 3.4.
3. Insert the correct key into the Program keyswitch and turn it to select Program Entry/Edit Mode.
4. Press 

. (Block No. Select)
5. Type the number of the first block you wish to program (leading zeros need not be entered, then press ENTER.

NOTE

At any time, if you make an error while entering data, press DEL (Delete) to delete the last data entered, then re-key the data and press ENTER.

You can use the N and LF (Line Feed) keys to successively increment the displayed block number.

6. Press DIALOG 

and FUNCTION? will appear in the display.

NOTE

To guard against accidental program changes, DIALOG must be pressed to program each block. After pressing DIALOG, you can exit Programming Mode without changing the block by pressing the Reset key.

7. Select positioning by pressing the Positioning key  .

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8. ABSOLUTE? appears in the display. In absolute positioning, all movements of the slide are made to some absolute distance from the machine reference position. Thus, if the slide is at +5 inches, a command to travel to +6 results in a 1 inch feed in the positive direction.

   Press LF (Line Feed) to select absolute positioning. If absolute positioning is not desired, skip to step 11.

   Note that absolute positioning must be selected in the first positioning command of the program, since program operation could begin at the home or toolchange position.

9. WITHOUT LAG? now appears in the display. If positioning with lag finishing is required, press the Lag Finishing key. This specifies that the slide must be stopped in position before any miscellaneous functions and block jumps) remaining in this block are executed or before the next block is executed.



   If positioning without lag finishing is OK, press LF (Line Feed). In this case, the position lag from one block will not be completed before the next block is executed.



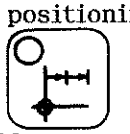
   See Section 5.3.7 for more information on positioning with/without lag finishing.

10. FEED RAMP? now appears in the display. Press the ENTER key if the feed ramp is to be used to control the acceleration/deceleration of speed changes involving this block.



    Press Line Feed if feed ramp is not applicable to this block.

11. Because absolute positioning was selected, DESTINATION? appears in the display. Key in the required destination as +/-xxx.xxxx inches or +/-xxxx.xxx mm. Note that the TRANS assumes a positive move if no sign is entered. The minus sign can be keyed before or after the number is keyed. Also note that the negative sign is a toggle; press to enter minus, press again to delete the number that is keyed. Also note that the negative sign is a toggle; press to enter minus, press again to delete minus. Now skip to step 16.

12. If absolute positioning is not desired, incremental positioning must be selected, by pressing 

13. WITHOUT LAG? now appears in the display. If positioning with lag finishing is required (slide stopped in position before the next function is executed), press the Lag Finishing key.

    If positioning without lag finishing is OK, press LF (Line Feed). In this case, the position lag from one block will not be completed before the next block is executed.

    See Section 5.3.7 for more information on positioning with/without lag finishing.

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14. FEED RAMP? now appears in the display. Press the ENTER key if the feed ramp is to be used to control the acceleration/deceleration of speed changes involving this block.



Press Line Feed if feed ramp is not applicable to this block.

15. Because incremental positioning was selected, "DISTANCE?" now appears in the display. Key in the required positioning distance as +/-xxx.xxxx inches or xxxx.xxx mm. When this command is executed, the slide will travel the specified distance from its current position in the specified direction.

16. When entering either distance or destination, if you make an error, press DEL (Delete) and re-key the data.

17. Whey your date is correct, press ENTER.

18. FEEDRATE? now appears in the display. Key in a feedrate value, then press ENTER. If you attempt to select a feedrate greater than the parameter-specified maximum rapid traverse speed (P16), the RANGE ERROR diagnostic occurs.

If you wish the feed to occur at rapid traverse rate, press the Rapid key. A fixed rapid rate, specified by program parameter P16, is then selected.



19. TOOL CORRECTION? now appears in the display. Press LF (Line Feed) if there is no requirement for operator-accessible dimension offsets, or if the tool correction register number (and its associated value) chosen in a previous block is still to be used.

To select a correction register, key in a number from 1 to 20 to specify the desired correction register, then press ENTER. You can then enter a value in that correction register which will be added to the dimension in this and all subsequent moves, until a different tool correction register is selected or the control is reset.

If you had selected a tool correction register in a previous block, but do not wish to use it in this or subsequent blocks, enter a tool correction register number of 0, then press ENTER.

20. AUX FUNCTION? now appears in the display. You can now step through and select any desired miscellaneous functions, such as auxiliary functions, BCD outputs, block jump, or block repeat. Selection of these functions (or skipping them) occurs in every block which is programmed. See Section 5.5.3.5 for a description of programming procedures.

Note that normal positioning and positioning using Feed Ramp are differentiated by the NC G-codes in the block display, where:

G1 - Normal positioning, with "instantaneous" speed changes
G6 - Positioning with continuous speed changes controlled by Feed Ramp.

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9.7 MODIFIED AUXILIARY OUTPUT FUNCTIONS

TRANS executive software version TR32 handles auxiliary output functions differently from standard TRANS software.

In standard software, the TRANS turns an auxiliary function on at the end of a block, then begins to decelerate the servomotor until an acknowledgment is received. Then the next block is executed. Even if the output is tied directly to the acknowledgment, some time is required to turn the output on, debounce the input, then read the input. Thus, time lags of around 30 msec may occur during which the drive is braked and not accelerated. These are normally partially compensated for in NC systems by the high mass moment of inertia.

This is totally compensated for in software version TR32. When a block is programmed without lag finishing, the TRANS turns the auxiliary output on at the end of a block, then immediately begins execution of the next block.

Program execution is continued for 50 msec without any interruptions. After 50 msec, the TRANS checks for correct acknowledgment of the output. If the acknowledgment has not been received, the TRANS diagnoses a fault and shuts the system down.

Note that movement is not interrupted at the end position of the block in which the switching function was programmed, but later in the path covered within the 50 msec.

9.8 TRANS INTERFACE MODULES

9.8.1 General Description

For situations where the TRANS I/O must be interfaced directly with devices requiring 115 Vac, rail-mounted interface modules are available. An assembly of interface modules, called a TIM (TRANS Interface Module), is composed of the following components:

* A number of input modules (115 Vac to 24 Vdc), called ACI's.
* A number of output modules (24 Vdc to 115 Vac), called AMMS's.
* A 35 mm mounting rail.
* Two end clamps.
* A number of jumpers to tie the +24 Vdc terminals on ACI modules together.
* A number of jumpers to tie the 0 Vdc terminals on AMMS modules together.

Normally a TIM is ordered by specifying the number of ACI and AMMS modules required. The TIM is then delivered with the rail cut and drilled to the required length, with the modules and end clamps mounted on it and the jumpers installed. For cases where the quantity per TIM is unknown, ACI and AMMS modules may be purchased mounted on 1 meter (39.4 in) rails, in which case cutting and drilling the rail must be done on site.

The dimensions and mounting information of a completed TIM are shown in drawing #109-556-3001-A. Notice that for both the ACI and AMMS, the terminals are designed so that 115 Vac always connects to screw-type terminals and 24 Vdc always connects to spade-type terminals.

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9.8.2 AC Input Modules

The ACI (AC Input Module) converts a 115 Vac input signal to a 24 Vdc output signal. The AC side of the circuit loads the driving device capacitively, so normal commercially available solid-state relays may be used without the necessity of an additional load.

Technical Data

Dimensions

Height:	55 mm (2.17 inches)
Width:	11.5 mm (0.45 inches)
Depth:	49 mm (1.93 inches)

Terminal Identification

Terminal 1 AC common	screw terminal
Terminal 2 AC signal input	screw terminal
Terminal 3 +24 V supply	spade terminal (2 x 2.8 x 0.8 mm)
Terminal 4 DC output	spade terminal (same as above)

Input Specifications

"On" voltage requirement	115 Vac + 15% (48-62 Hz)
"Off" voltage requirement	0-35 Vac (48-62 Hz)
Input impedance (48-62) Hz	6200-4200 Hz (capacitive)
Input current at 115 Vac	28 ma at 60 Hz
	20 ma at 50 Hz

Output Specifications

Output voltage	+24 Vdc, +20%
Maximum output current	100 ma
Current limit level	about 110 ma

Output is short circuit proof and polarity protected.

Switching Times

Turn-on	15 msec
Turn-off	30 msec

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9.8.3 AC Output Modules

The AMMS module converts a 24 Vdc input signal to a 115 Vac output signal.

Technical Data

Dimensions

Height:	55 mm (2.17 inches)
Width:	11.5 mm (0.45 inches)
Depth:	49 mm (1.93 inches)

Terminal Identification

Terminal 1 DC signal input	spade terminal (2 x 2.8 x 0.8 mm)
Terminal 2 DC common	spade terminal (2 x 2.8 x 0.8 mm)
Terminal 3 AC output	screw terminal
Terminal 4 AC line input	screw terminal

Input Specifications

"On" voltage requirement	4-30 Vdc
"Off" voltage requirement	Greater than 2 Vdc
Maximum input current	10 ma

Output Specifications

Output voltage	24-280 Vac
Maximum output current	1.2 A

9.9 USING A TRANS WITH A LINEAR SCALE

9.9.1 Introduction

The TRANS may be used with a linear scale providing incremental encoder-type outputs without any modifications to the TRANS. The AC servomotor used in such an application does not require position feedback, only tach and commutation feedback.

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9.9.2 Parameter Adaption

When using a linear scale, parameter P06 (Encoder Cycles/Rev) must be calculated using the following formula:

$$\frac{\text{Ballscrew Lead} * \text{EXE multiplication factor}}{\text{Linear scale constant} * \text{Gear reduction}} = \text{Encoder Cycles/Rev.}$$

Example:		
	Ballscrew Lead	= 10 mm
	EXE Mult. Factor	= 5
	Gear Reduction	= 2:1
	Linear Scale Constant	= 10 um

$$\frac{10.000 \text{ mm} * 5}{20 \text{ um} * 5} = 1250 \text{ Cycles/Rev}$$

All other TRANS parameters are entered as normal.

9.9.3 Pulse Weight

If the pulse weight of the completed system is required, it may be calculated as follows:

$$\frac{\text{Linear Scale Constant}}{\text{EXE Mult. Factor} * \text{TRANS Multiplication factor}}$$

In the above example, this would be:

$$\frac{20 \text{ um}}{5 * 4} = 1 \text{ um}$$

(Note: the TRANS always multiplies by four.)

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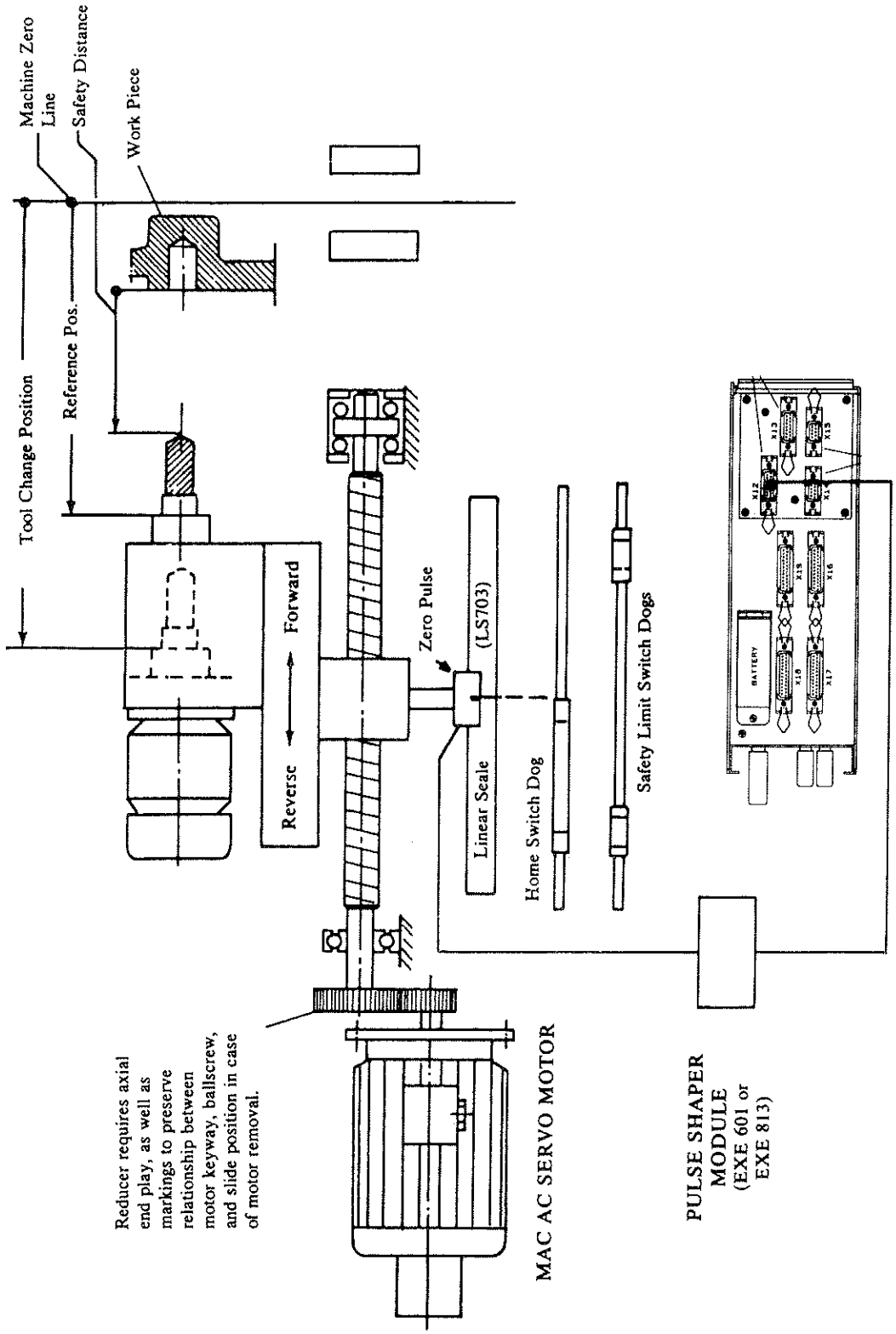


Figure 9-11. Linear Scale Application With TRANS

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APPENDIX A. PARAMETER RECORD SHEETS

The following pages are the parameter record sheets for the Modular TRANS. Note that when certain options are not included in a control, parameter numbers associated with those options will not be present in the software.

It is suggested that the parameters programmed in a TRANS be promptly documented and a copy of the form placed on or near the machine as a handy record. See Chapter 4 for information on reading/entering system parameters.

To determine the software version of a TRANS, refer to the label located on the front of the TRANS cabinet. Alternatively, the REV key on the TAM panel may be pressed in Manual mode, and the software version will appear on the display as follows:

```
                                                N000 TR 30 - 005.0US
                                                 :    :      :   :
                                                 :    :      :   :
Block Number.....................................:    :      :   :
                                                      :      :   :
Version..............................................:      :   :
                                                             :   :
Revision.....................................................:   :
                                                                 :
Language.........................................................:
  US = English (U.S.)
  D  = German
  I  = Italian
  F  = French
  S  = Swedish
```


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PARAMETER RECORD SHEET -- TRANS-01 M

Machine Number _____ Axis/Unit _____

Form Completed By _____ Date _____

Key	No.	Parameter	Value			
	P00	TRANS-NUMBER	¦ ¦ ¦			
	P01	TRANS-GROUP NUMBER	¦ ¦			
	P02	SERIAL CYCLE INPUTS	¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦			
	P03	SERIAL ACKN-INPUTS	¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦			
	P04	SERIAL CONDITIONS	¦ ¦			
3	P05	UNITS	¦ ¦	1 = INCHES		0 = MM
	P06	ENCODER CYCLES/REV	¦ ¦ ¦ ¦ ¦			
3	P07	BALLSCREW LEAD		¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦ in	¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦	
2	P07	UNITS/TABLE REV		¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦	¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦	
	P08	GEARBOX REV IN	¦ ¦ ¦ ¦ ¦			
	P09	GEARBOX REV OUT	¦ ¦ ¦ ¦ ¦			
3	P10	+ TRAVEL LIMIT		¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦ in	¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦	
3	P11	- TRAVEL LIMIT		¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦ in	¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦	
	P12	REFERENCE POSITION		¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦ in	¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦	
	P13	MOTOR RPM/10 VOLTS	¦ ¦ ¦ ¦ ¦			
	P14	KV FACTOR	¦ ¦ ¦			
	P15	HOMING SPEED		¦ ¦ ¦ ¦ ¦ ¦ ipm	¦ ¦ ¦ ¦ ¦ ¦	mm/min
	P16	RAPID SPEED		¦ ¦ ¦ ¦ ¦ ¦ ¦ ipm	¦ ¦ ¦ ¦ ¦ ¦ ¦	mm/min
	P17	JOGGING SPEED		¦ ¦ ¦ ¦ ¦ ¦ ipm	¦ ¦ ¦ ¦ ¦ ¦	mm/min
	P18	JOGGING RAPID		¦ ¦ ¦ ¦ ¦ ¦ ipm	¦ ¦ ¦ ¦ ¦ ¦	mm/min
	P19	RAMP		¦ ¦ ¦ ¦ ¦ in/s^2	¦ ¦ ¦ ¦ ¦	mm/s^2

See page A-5 for an explanation of the key.

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PARAMETER RECORD SHEET -- TRANS-01 M. Cont'd.

Key	No.	Parameter	Value		
	P20	MAX FEEDRATE		ipm	mm/min
	P21	RETRACT		in	mm
	P22	DIRECTION POLARITY		(0/1)	
	P23	HOMING DIRECTION		(0 = +, 1 = -)	
	P24	JOGGING DIRECTION		(0/1)	
	P25	MAX FEEDRATE FOR G5		ipm	mm/min
5	P26	% TORQUE TO POS STOP			
5	P27	% TORQUE AT POS STOP			
	P28	AUX OUTP AT EM STOP			
	P29	AUX OUTP AT IM STOP			
4	P30	NOM CURRENT (A)			
4	P31	MAX NO-THR-CURRENT			
6	P32	LIN-ENC-RESOLUTION		in	mm
6	P33	LIN-ENCODER DIRECTION		(0 = -, 1 = -)	
6	P34	MAX LIN-ENC-DEFL		in	mm
6	P35	LIN-ENCODER PRE-LIMIT		in	mm
1	P36	FEED RAMP		in/sec^2	mm/sec^2
7	P37	SPINDLE DIRECTION		(0/1)	
7	P38	SPINDLE RPM/10 VOLTS			
7	P39	MAXIMUM CORRECTION		in	mm
7	P40	OPERATION MODE 1			
7	P41	OPERATION MODE 2			

See the following page for an explanation of the key.

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EXPLANATION OF KEY

1 This parameter will be present only with version TR32 software.

2 This parameter will be present only with version TR33 software.

3 These parameters will NOT be present with version TR33 software.

4 This parameter will be present only with version TR34 software.

5 These parameters will NOT be present with version TR35 software.

6 These parameters will be present only with version TR35 software.

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APPENDIX B. HARDWARE AND SOFTWARE TYPE-CODE KEYS

B.1 TRANS HARDWARE TYPE-CODE KEY

```
                                                    TRANS-01 M XX . G A C F
                                                          :     :
                                                          :     :
Control Name:.....................................................:     :
                                                                :
Revision Index Number:...........................................:
   00 = Original Release
   01 =
   02 = Switch selected TRANS number
```

B.2 TRANS EXECUTIVE SOFTWARE TYPE-CODE KEY

```
                                                    TR 30 - XXX.X US
                                                    :  :     :    :
                                                    :  :     :    :
TRANS Executive Software:.....................................:  :     :    :
                                                       :     :    :
Software Version..............................................:     :    :
   30 - 39 = Standard Software                                :    :
   (see software detail, next page)                           :    :
                                                              :    :
Revision Index:...............................................:    :
   Major revisions                                                 :
   Patch revision                                                  :
                                                                   :
Language:..........................................................:
   US - English
   DE - German
   IT - Italian
   SW - Swedish
   FR - French
   ES - Spanish
```


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B.3 TRANS EXECUTIVE SOFTWARE DETAIL

Type & Index	Description	Languages
TR30	Standard Software	US
TR32	Feed Ramp	US
TR33	Rotary Axis Software	US
TR34	Adaptive Feed Control	US
TR35	Adaptive Depth Control Only	US

B.4 TYPE CODE FOR TAM 2

TAM 2.XX.XX

Equipment Type:

Equipment Options:

-- TAM with handle for carrying w/o locking door

01 TAM with front locking door and cabinet mounting capability with rear mounting of TAM bus, w/o carrying handle

REVISION INDEX 00 - 99:

-- Early Software TAM 02

01 TAM 2 software superseding through TAM 03

02 TAM 2 software superseding through TAM 04

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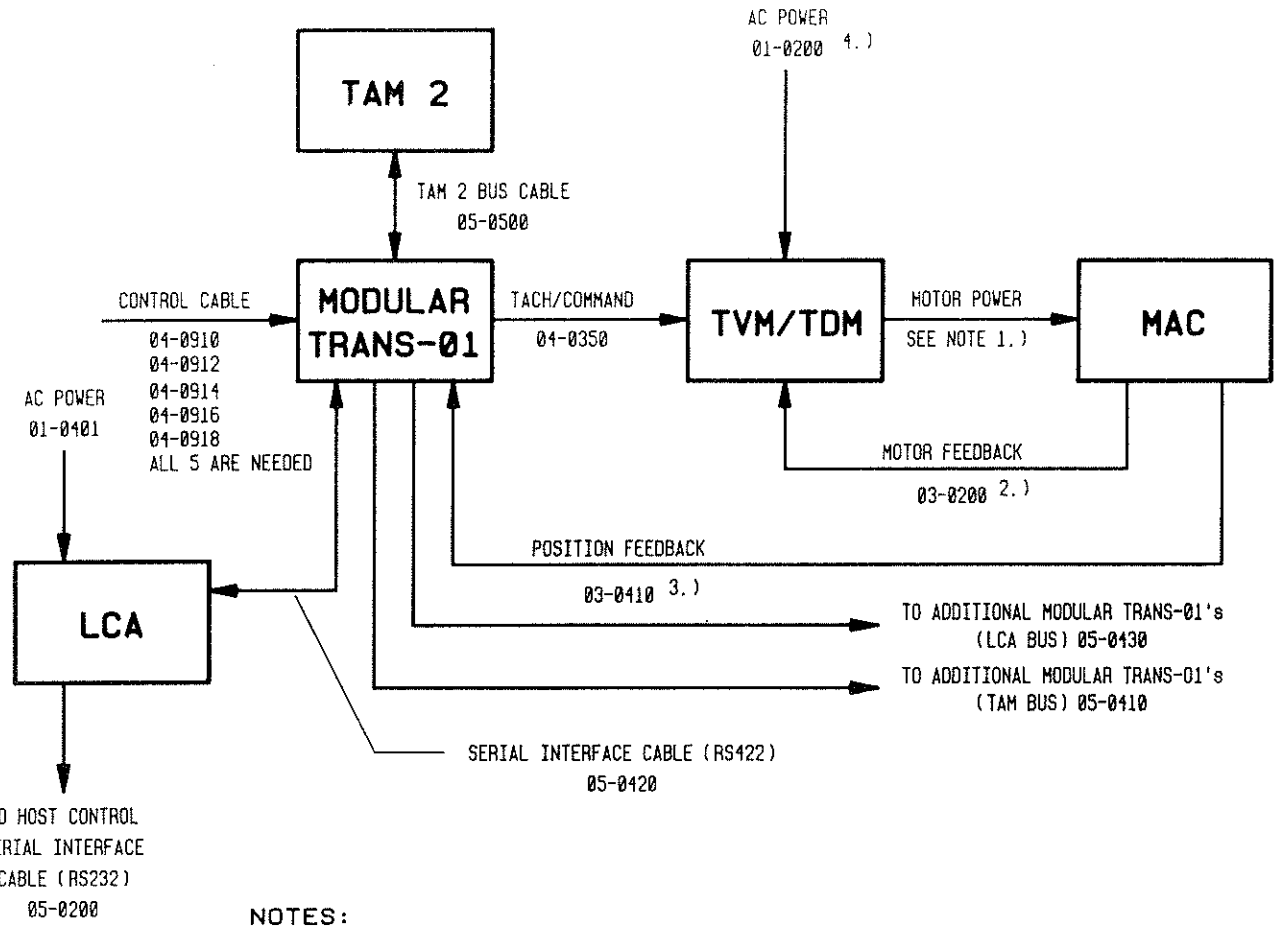
APPENDIX C. TRANS SYSTEM CABLE DRAWINGS

C.1 INTRODUCTION

This appendix consists of a series of cable drawings, including

* System Cable Requirements
* Position Feedback Cables
* NC Cables
* Control Cable

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NOTES:

1.) MOTOR POWER CABLES ARE SELECTED BASED ON SPECIFIC MOTOR/DRIVE COMBINATION. REFER TO "MOTOR POWER CABLE SELECTION LIST" FOR PART NUMBERS.

2.) USE CABLE 03-0201 IF MOTOR HAS BLOWER
USE CABLE 03-0230 FOR RIGHT ANGLE CONNECTOR

3.) USE CABLE 03-0411 IF MOTOR HAS BLOWER
USE CABLE 03-0430 FOR RIGHT ANGLE CONNECTOR

4.) 8 AWG WIRE MUST BE USED FOR TVM POWER WITH THE FOLLOWING MOTORS

MAC 112B-1-GD
MAC 112C-0-KD
MAC 112C-1-KD
MAC 112C-0-HD
MAC 112C-1-HD
MAC 112C-0-ED
MAC 112C-1-ED
AND ALL MAC 112 D's.

REXROTH INDRAMAT
CHICAGO ILL.

SYSTEM CABLE REQUIREMENTS

DRAWING NUMBER AG 1020

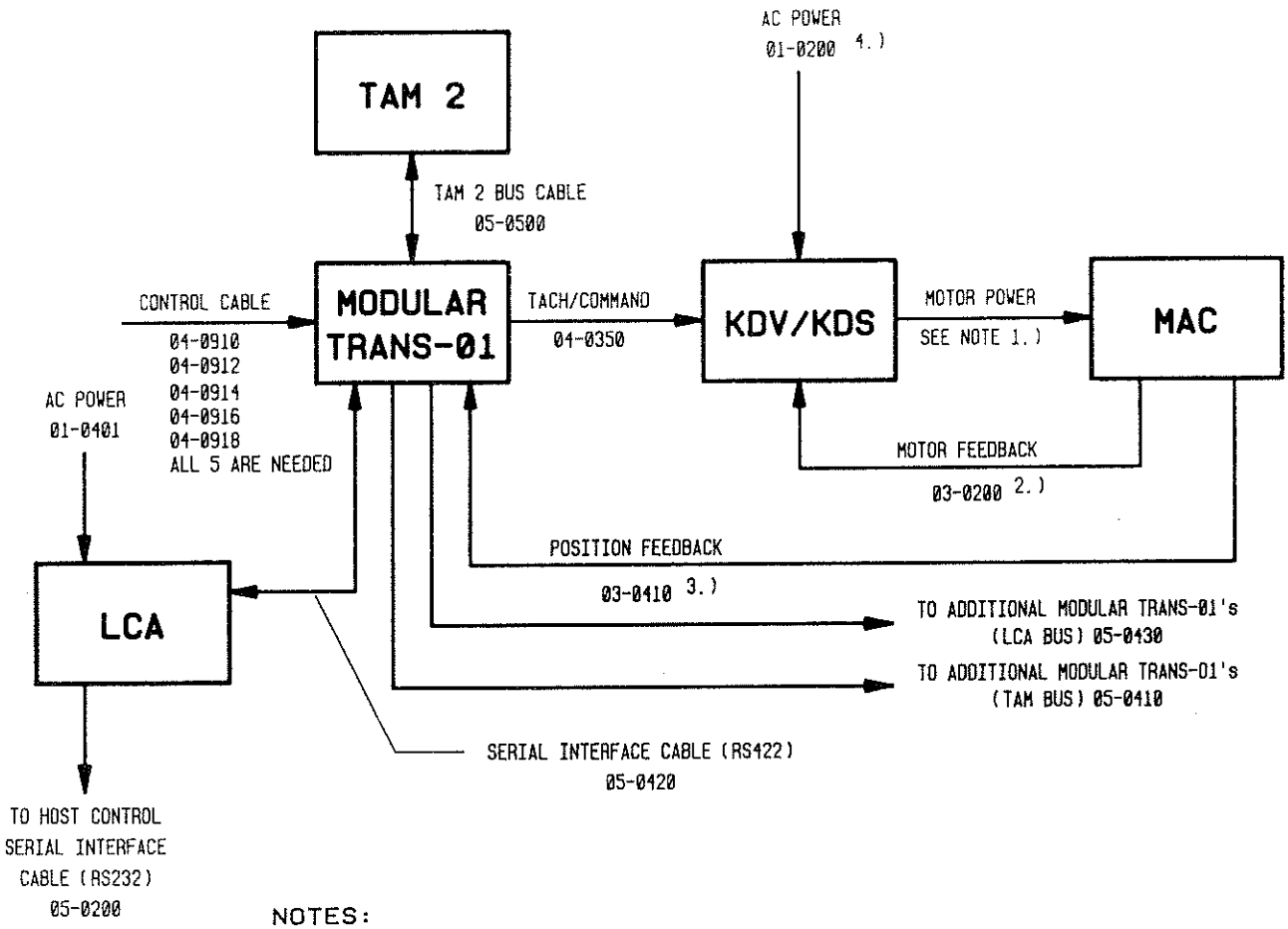
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NOTES:

1.) MOTOR POWER CABLES ARE SELECTED BASED ON SPECIFIC MOTOR/DRIVE COMBINATION. REFER TO "MOTOR POWER CABLE SELECTION LIST" FOR PART NUMBERS.

2.) USE CABLE 03-0201 IF MOTOR HAS BLOWER
USE CABLE 03-0230 FOR RIGHT ANGLE CONNECTOR

3.) USE CABLE 03-0411 IF MOTOR HAS BLOWER
USE CABLE 03-0430 FOR RIGHT ANGLE CONNECTOR

4.) 8 AWG WIRE MUST BE USED FOR KDV POWER WITH THE FOLLOWING MOTORS

MAC 112B-1-GD
MAC 112C-0-KD
MAC 112C-1-KD
MAC 112C-0-HD
MAC 112C-1-HD
MAC 112C-0-ED
MAC 112C-1-ED
AND ALL MAC 112 D's.

REXROTH INDRAMAT CHICAGO ILL.	SYSTEM CABLE REQUIREMENTS			Rev.	Description	Date	Init.
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DRAWN BY 2-23-87	APPROVED BY	SCALE N.T.S.	REVISION FOR / REVISED BY	SHEET 10 OF 14			

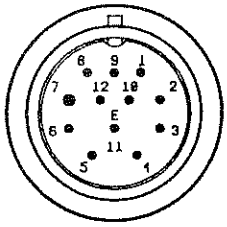
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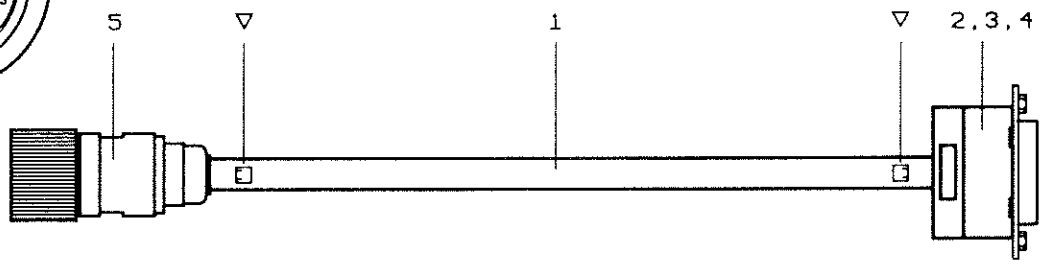
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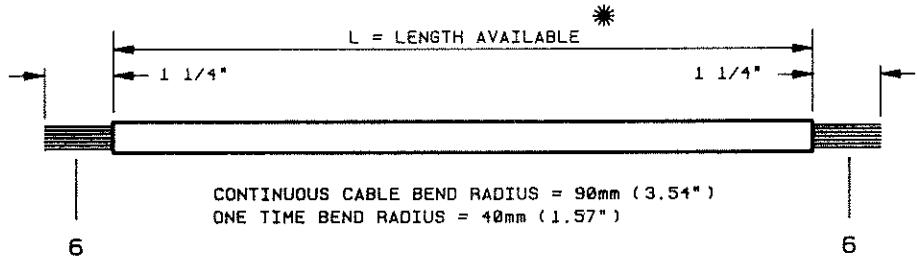
MAC-TRANS 01M 03-0410

DETAIL OF IN 101 CONNECTOR
12 PIN FEMALE KEY ON 7



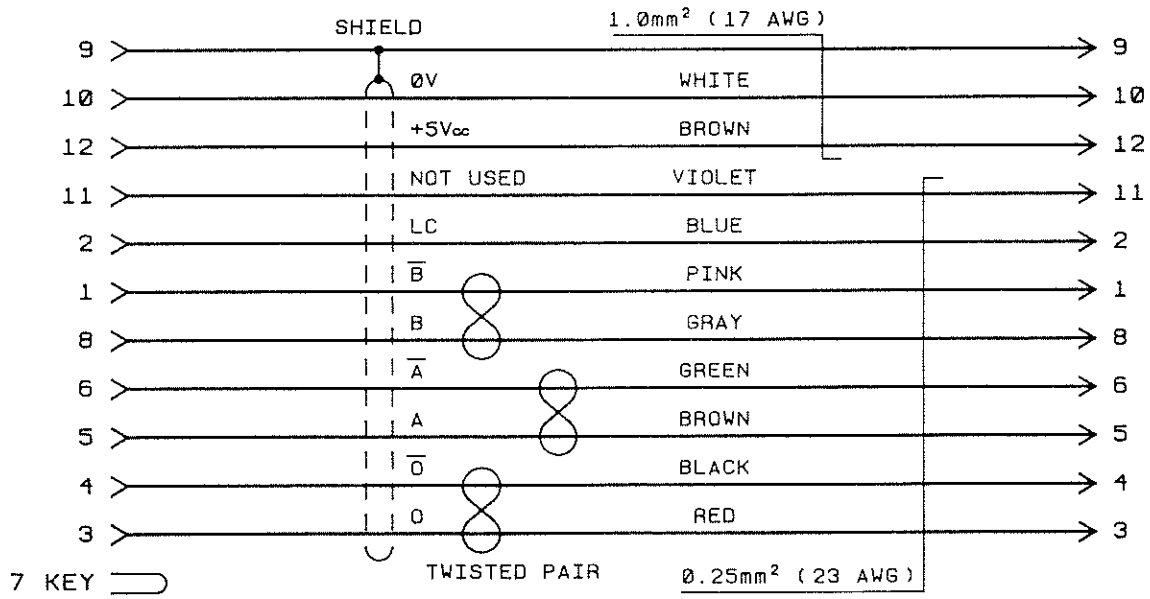


CONNECTOR OUTLINE FEMALE



TO MOTOR ST.B CONNECTOR

TO MODULAR-TRANS X12



CABLE: 4x2x0.25mm² + 2x1.0mm²

✱ MAXIMUM POSITION FEEDBACK CABLE LENGTH IS 30 METERS (98.43 FEET)

REXROTH INDRAMAT
CHICAGO ILL.

POSITION FEEDBACK CABLE

DRAWING NUMBER 209-0036-4830-00A

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10-26-87		NTS		1 OF 2

Rev.	Description	Date	Init.
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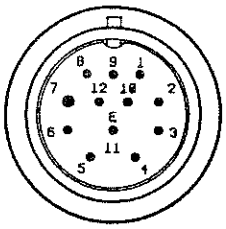
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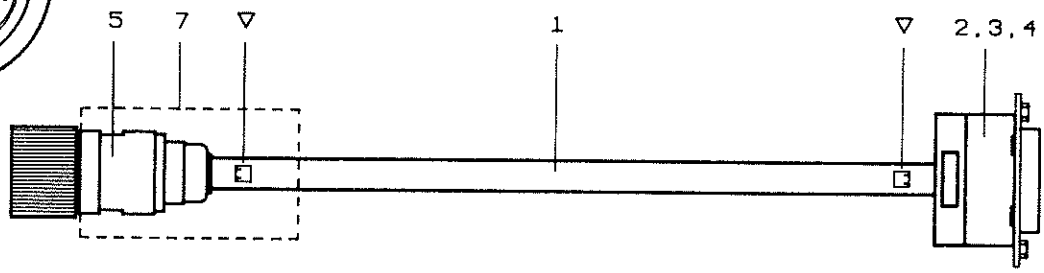
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MAC-TRANS 01M 03-0411

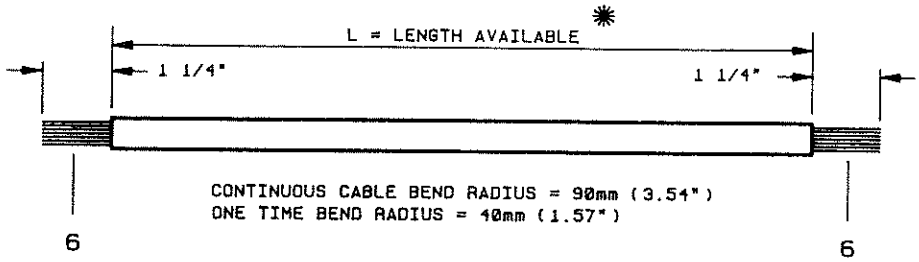
DETAIL OF IN 101 CONNECTOR
12 PIN FEMALE KEY ON 7





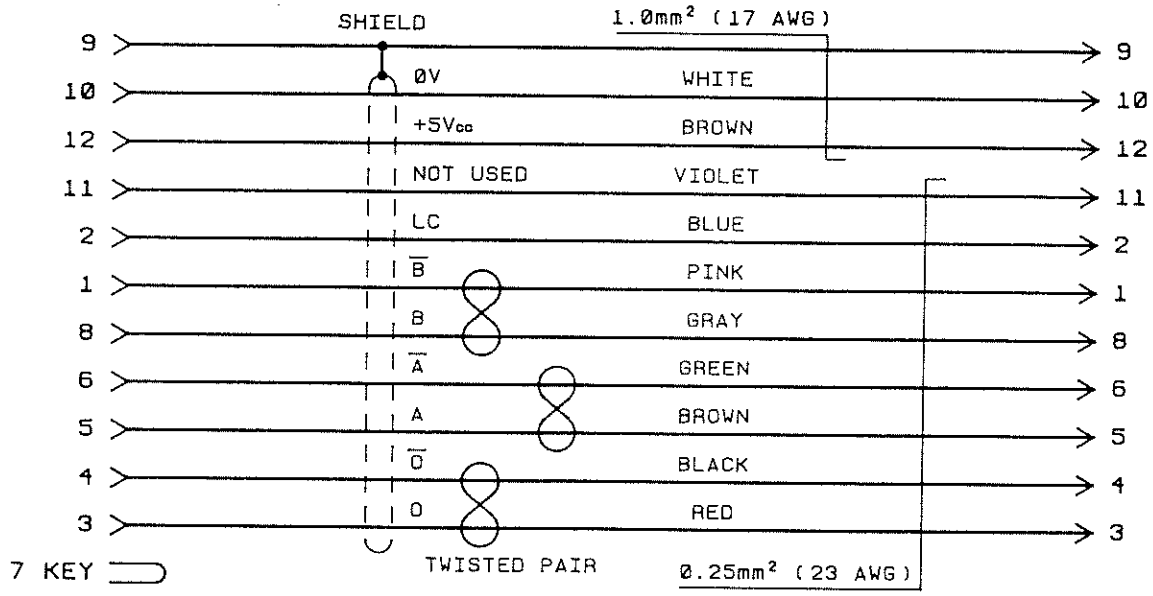


CONNECTOR
OUTLINE
FEMALE



TO MOTOR ST.8
CONNECTOR

TO MODULAR-TRANS
X12



CABLE: $4x2x0.25mm^2 + 2x1.0mm^2$

✱ MAXIMUM POSITION FEEDBACK CABLE LENGTH IS 30 METERS (98.43 FEET)

REXROTH INDRAMAT CHICAGO ILL.	POSITION FEEDBACK CABLE WITH SLEEVE			Rev.	Description	Date	Init.
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DRAWN BY 10-26-87	APPROVED BY	SCALE NTS	REVISION FOR / REVISED BY	SHEET 1 OF 2			

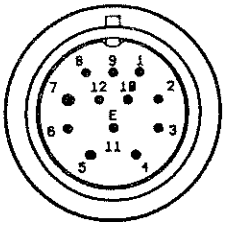
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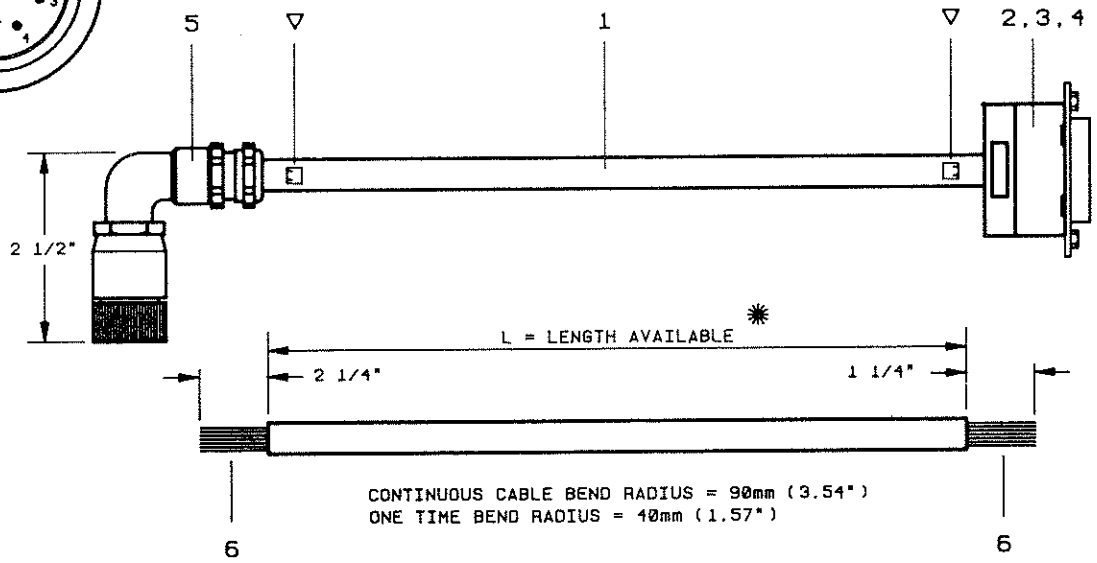
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MAC-TRANS 01M 03-0431

DETAIL OF IN 101 CONNECTOR
12 PIN FEMALE KEY ON 7

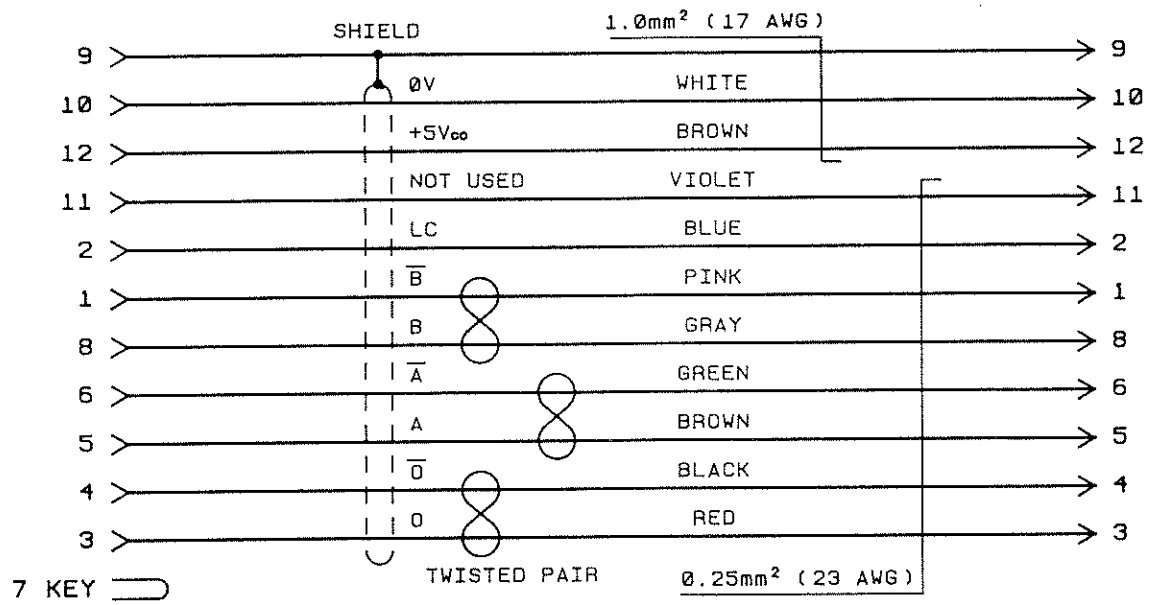




CONNECTOR OUTLINE FEMALE

TO MOTOR ST.B CONNECTOR

TO MODULAR-TRANS X12



CABLE: 4x2x0.25mm² + 2x1.0mm²

✱ MAXIMUM POSITION FEEDBACK CABLE LENGTH IS 30 METERS (98.43 FEET)

REXROTH INDRAMAT
CHICAGO ILL.

POSITION FEEDBACK CABLE WITH RIGHT ANGLE

DRAWING NUMBER

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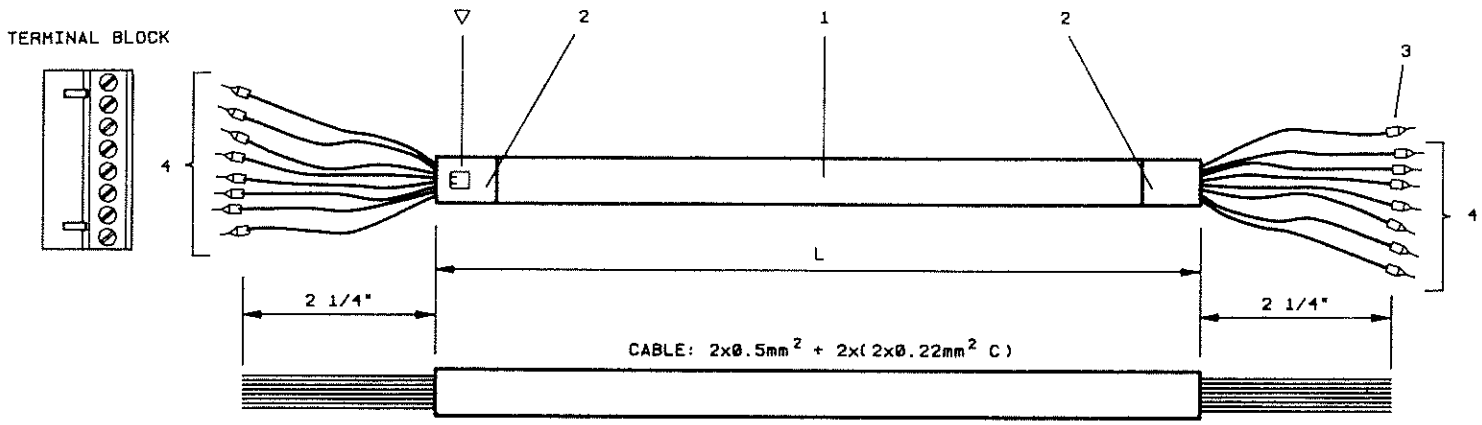
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A	REDRAWN	OCT 87	DA

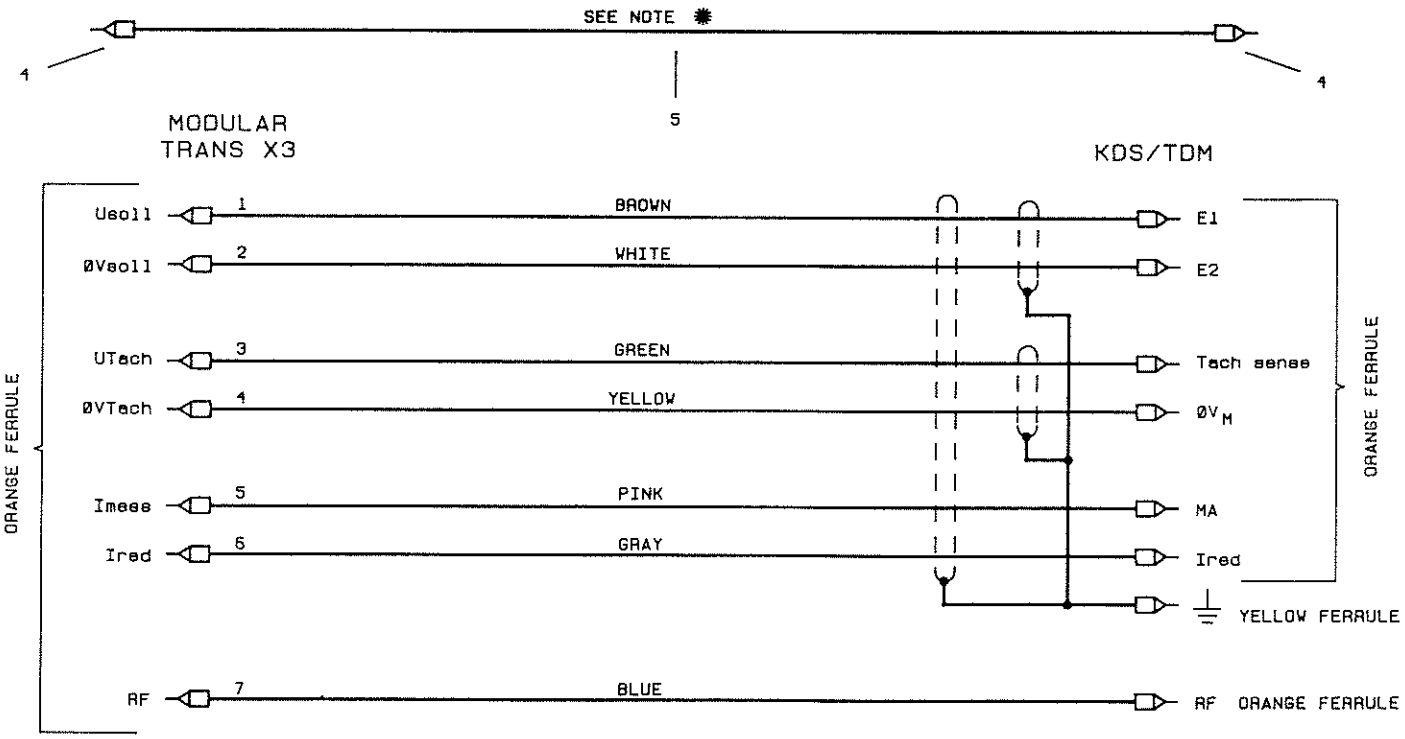
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X3 TACH - COMMAND CABLE - 04-0350





✹ ALONG OUTSIDE OF CABLE FASTEN A MULTI STRANDED BLUE WIRE (0.5mm² = 20 AWG) FOR THE RF SIGNAL.

REXROTH INDRAMAT
CHICAGO ILL.

X3 TACH / COMMAND CABLE TRANS 01M X3 TO KDS/TDM

DRAWING NUMBER 209-0036-4829-00A

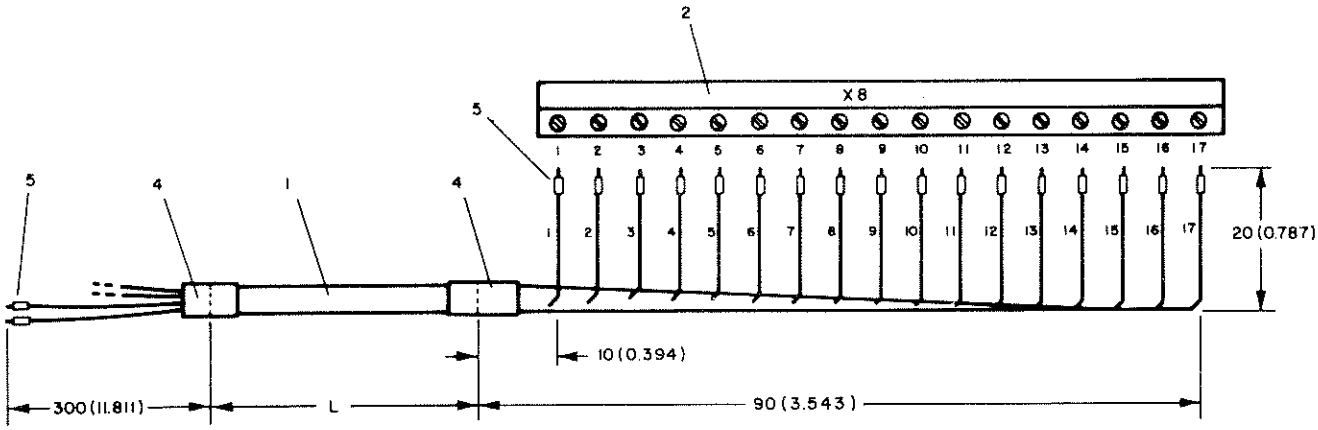
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X8 CONTROL CABLE 04-0912



TO TERMINAL STRIP

TO X8 ON TRANS 01-M

WIRE COLOR			FUNCTION	PIN NUMBER
white	=	Bb CONTROLLER 1	INPUT 16	1
brown	=	Bb CONTROLLER 2 24V	" 15	2
green	=	MOTOR TAS 1	" 14	3
yellow	=	E-STOP	" 13	4
gray	=	SAFETY LIMIT	" 12	5
pink	=	HOME L.S.	" 11	6
blue	=	NEG. TRAVEL L.S.	" 10	7
red	=	POS. TRAVEL L.S.	" 9	8
black	=	ACKNOWLEDGEMENT 7	" 8	9
violet	=	" 6	" 7	10
gray/pink	=	" 5	" 6	11
red/blue	=	" 4	" 5	12
white/green	=	" 3	" 4	13
brown/green	=	" 2	" 3	14
white/yellow	=	" 1	" 2	15
yellow/brown	=	" 0	" 1	16
white/gray	=	UNUSED	UNUSED	17
gray/brown	=	NOT USED	NOT USED	

ORANGE FERRULE

WIRE SIZE 0.25 mm^2 (23 AWG)

NOTE: ALL DIMENSIONS ARE SHOWN IN "mm" (inch) FOR REFERENCE ONLY.

REXROTH INDRAMAT
CHICAGO ILL.

X8 CONTROL CABLE FOR TRANS01M

DRAWING NUMBER 209-0036-4817-01/02A

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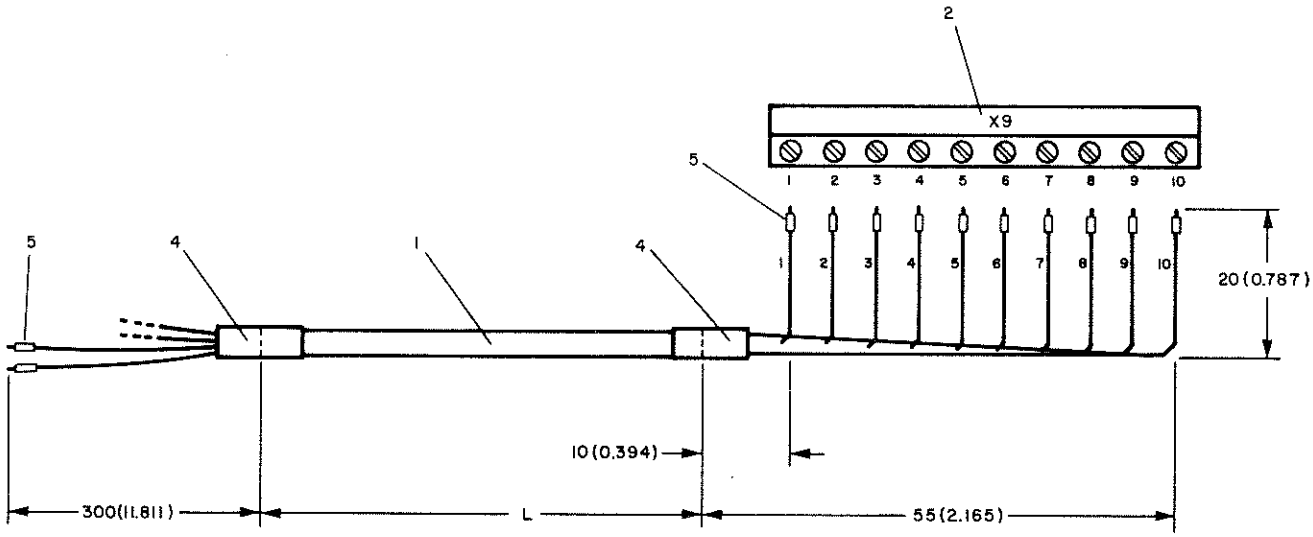
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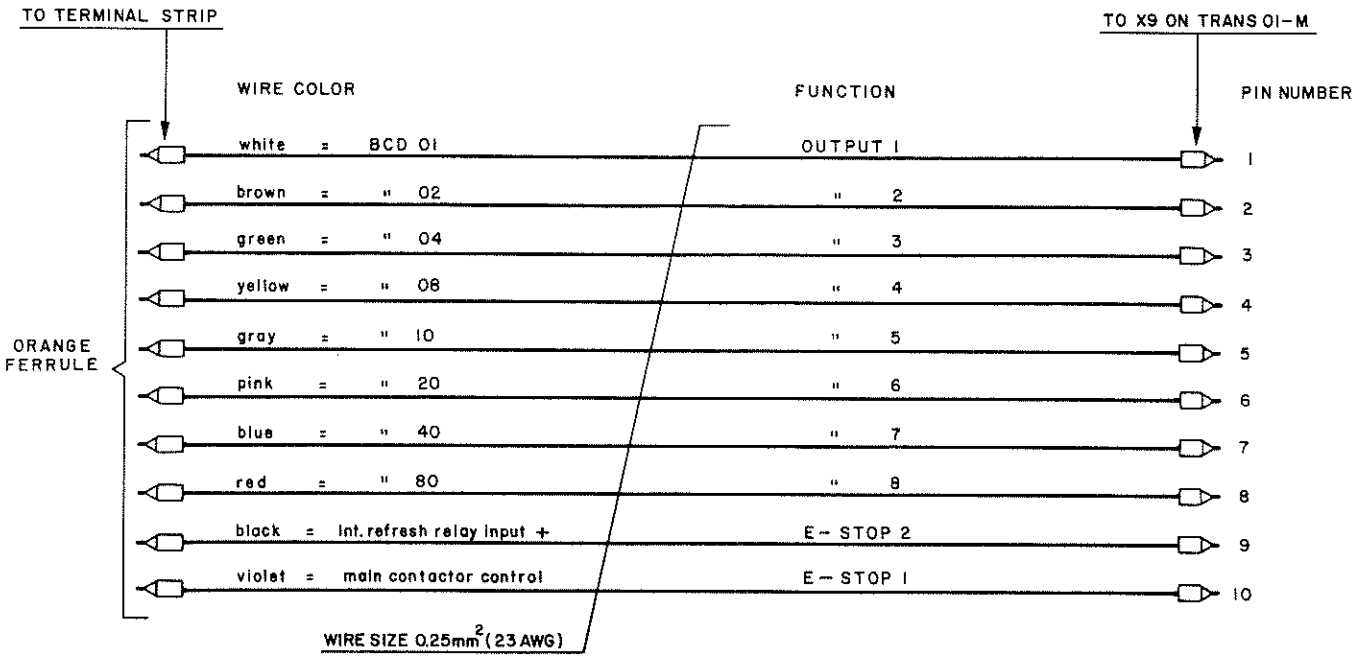
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X9 CONTROL CABLE 04-0914





NOTE:
ALL DIMENSIONS ARE SHOWN IN "mm" (inch) FOR REFERENCE ONLY.

REXROTH INDRAMAT CHICAGO ILL.	**X9 CONTROL CABLE FOR TRANS 01 M**				
	DRAWING NUMBER 209-0036-4817-01/03A				
DRAWN BY 8-28-85	APPROVED BY 9-16-85	SCALE N.T.S.	REVISION FOR / REVISED BY	SHEET 1 OF 2	

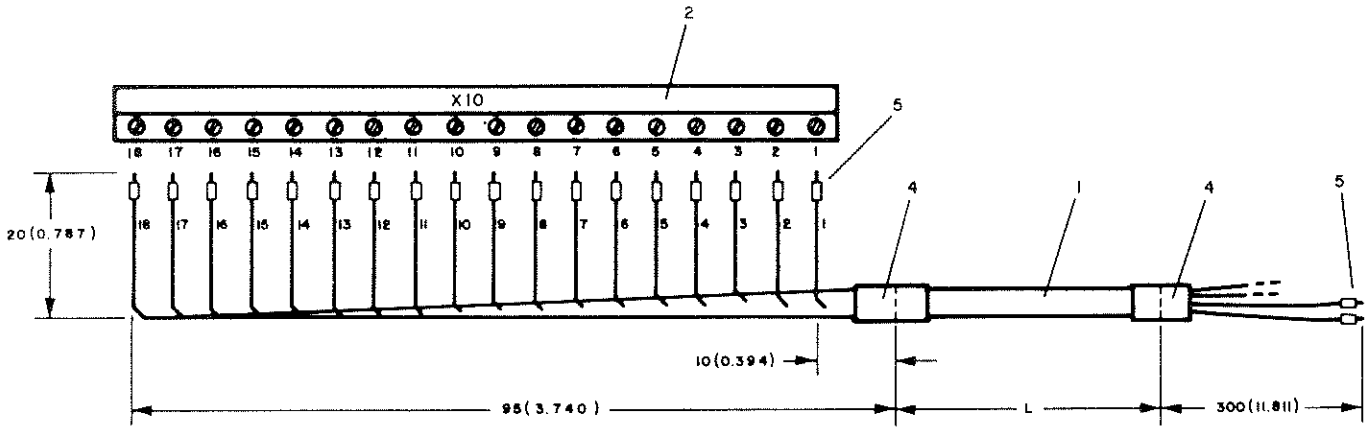
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X10 CONTROL CABLE-04-0916



TO TERMINAL STRIP

TO X10 ON TRANS 01-M

WIRE COLOR			FUNCTION	PIN NUMBER
white	=	RF 2 UNUSED	RF 2	1
brown	=	RF 1 UNUSED	RF 1	2
green	=	UNUSED	OUTPUT 9	3
yellow	=	UNUSED	" 10	4
gray	=	BRAKE RELEASE	" 11	5
pink	=	$\overline{\text{FAULT}}$	" 12	6
blue	=	POWER INTERRUPT	" 13	7
red	=	HOME	" 14	8
black	=	RUN	" 15	9
violet	=	READY	" 16	10
gray/pink	=	AUXILIARY FUNC. 7	" 17	11
red/blue	=	" " 6	" 18	12
white/green	=	" " 5	" 19	13
brown/green	=	" " 4	" 20	14
white/yellow	=	" " 3	" 21	15
yellow/brown	=	" " 2	" 22	16
white/gray	=	" " 1	" 23	17
gray/brown	=	" " 0	" 24	18

ORANGE FERRULE

WIRE SIZE 0.25mm² (23AWG)

NOTE: ALL DIMENSIONS ARE SHOWN IN "mm" (inch) FOR REFERENCE ONLY.

REXROTH INDRAMAT
CHICAGO ILL.

X10 CONTROL CABLE FOR TRANSOIM

DRAWING NUMBER 209-0036-4817-01/04A

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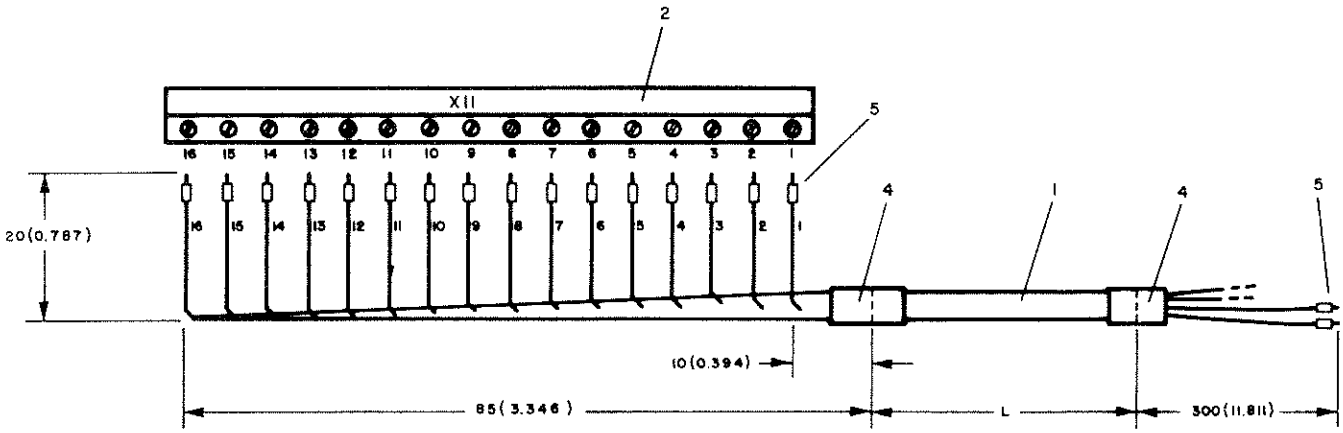
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XII CONTROL CABLE-04-0918



TO TERMINAL STRIP

TO XII ON TRANSOI-M

WIRE COLOR			FUNCTION	PIN NUMBER
white	=	HOMING	INPUT 17	1
brown	=	AUTO/MANUAL	" 18	2
green	=	ENABLE	" 19	3
yellow	=	RE-START	" 20	4
gray	=	CONDITIONAL JUMP 2^0	" 21	5
pink	=	" " 2^1	" 22	6
blue	=	" " 2^2	" 23	7
red	=	" " 2^3	" 24	8
black	=	FORWARD	" 25	9
violet	=	REVERSE	" 26	10
gray/pink	=	START	" 27	11
red/blue	=	ENABLE FORWARD	" 28	12
white/green	=	TOOL CHANGE	" 29	13
brown/green	=	MANUAL SPINDLE ENABLE	" 30	14
white/yellow	=	N actual = N commanded JUMPER ON+OFF " TO 31 24	" 31	15
yellow/brown	=	MOTOR TAS 2	" 32	16
white/gray	=	NOT USED	NOT USED	
gray/brown	=	NOT USED	NOT USED	

ORANGE FERRULE

WIRE SIZE 0.25mm² (23AWG)

NOTE: ALL DIMENSIONS ARE SHOWN IN "mm" (inch) FOR REFERENCE ONLY.

REXROTH INDRAMAT
CHICAGO ILL.

XII CONTROL CABLE FOR TRANSOIM

DRAWING NUMBER 209-0036-4817-01/05A

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USER'S MANUAL
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